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Monireh Amini, Department of Computer Engineering, Zanjan Branch, Islamic Azad University, Zanjan, Iran
Mahdi Nasiri, Computer Engineering Department, Iran University of Science and Technology, Tehran, Iran

Abstract — Nowadays, with confronted huge volumes of data produced in the world that created this data in organizations, banks, military centers, hospitals, etc. Recommender systems are generated to deal with the problems of huge volumes of data. These systems help to users in many different fields among the massive volume of information to make the right decision. Recommender system by analyzing user behavior suggests to users appropriate services, like electronic stores. Also in today's world, the Internet provides vast amount of data to users.
But if not available effective management on aggregate data, these data will be a barrier to progress. Nowadays, with the development of information systems need before than capable of directing users towards goods and services they are desire. But if effective management on aggregate data is not available, these data will be a barrier to progress. Therefore, in this article we offer a new proposed approach by using a hybrid method. To evaluate the proposed approach we used Movie Lens standard dataset. Also we used two techniques of collaborative filtering and content based filtering. For the proposed approach we offer four models. Finally, these models compared by accuracy of prediction and classification error.

Keywords: Recommender System, Collaborative Filtering, Content-Based Filtering, Hybrid Filtering, Spiking Neural Network

2. Paper 30091412: Virtualization and Live Migration in VirtualBox (pp. 7-11)

Ledina Karteri (1), Aurora Çenga (2), Igli Tafa (3), Julian Fejzaj (4)
Europian University of Tirana (1)
Polytechnic University of Tirana (2,3)
Tirana University (4)

Abstract — Virtualization is a very efficient mechanism that has improved machines use. This technique has been implemented in many systems and it helps utilize a single physical machine to run different operating systems simultaneously. Another benefit of virtualization is Live Migration. Such feature allows us to move virtual machines to different hosts easily. In this article I will install different operating systems in my laptop and try to migrate them to another computer to share data in a short amount of time.

Keywords: virtualization; teleportation; virtual machine; hypervisor; live migration;

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N. M. El-Gohary (1), F. E. Abd El-Samie (2) & M. M.Fouad (1)
(1) Department of Electronics and Communication, Faculty of Engineering, Zagazig University, Egypt.
(2) Department of Electronics and Communication, Faculty of Electronics Engineering, Menofia University, Egypt.

Abstract - In wireless, satellite, and space communication systems reducing error is critical. High bit error rates of the wireless communication system require employing various coding methods on the data transferred. To address the large latency and degraded network throughput due to the retransmission triggered by frame loss in high speed wireless networks, the purpose of this paper is to study and investigate the performance of fountain codes that is used to encode and decode the data stream in digital communication. This solution intelligently encodes a number of

redundant frames from original frames upon link loss rate so that a receiver can effectively recover lost original frames without significant retransmissions. Since then, many digital Fountain coding methods have been invented such as Tornado codes, Luby transform (LT) codes and Raptor codes.

Keywords: wireless communication systems, fountain codes, Tornado codes, Luby transform, Raptor codes

4. Paper 31081347: An Optimal Energy-Efficient Clustering Protocol in Wireless Sensor Networks Using Genetic Algorithm (pp. 26-30)

Ayat Kazemi, Department of Computer Engineering, Science and Research Branch, Islamic Azad University, Boroujerd, Iran
Ehsan akhtarkavan, Electronic and Computer Engineering, Islamic Azad University, Garmsar branch, Garmsar, Iran

Abstract — A sensor network has many sensor nodes with limited energy. One of the important issues in these networks is the increase of the life time of the network. This paper proposes a hybrid algorithm which, acts on the network and using genetic algorithm at first stage to choose the best sensors as a cluster head and using sleep/wake up mechanism for redundant sensors in the second stage. This algorithm will balance the energy consumption in the network and improve the network life time and coverage preservation.

Keywords-component, Wireless Sensor Network, Genetic Algorithm, Clustering, Sleep/Wakeup Mechanism, lifetime.

New Approach in hybrid Movie Recommender Systems Using Collaborative Filtering and Content-Based Filtering Methods

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Abstract*:* Nowadays, with confronted huge volumes of data produced in the world that created this data in organizations, banks, military centers, hospitals, etc. Recommender systems are generated to deal with the problems of huge volumes of data. These systems help to users in many different fields among the massive volume of information to make the right decision. Recommender system by analyzing user behavior suggests to users appropriate services, like electronic stores. Also in today's world, the Internet provides vast amount of data to users. But if not available effective management on aggregate data, these data will be a barrier to progress. Nowadays, with the development of information systems need before than capable of directing users towards goods and services they are desire. But if effective management on aggregate data is not available, these data will be a barrier to progress. Therefore, in this article we offer a new proposed approach by using a hybrid method. To evaluate the proposed approach we used MovieLens standard dataset. Also we used two techniques of collaborative filtering and content based filtering. For the proposed approach we offer four models. Finally, these models compared by accuracy of prediction and classification error.

Keywords: Recommender System, Collaborative Filtering, Content-Based Filtering, Hybrid Filtering, Spiking Neural Network

1. INTRODUCTION

Recommender systems are nowadays an essential web application [1], which by filtering offers useful information. Many of electronic websites use recommender systems, such as online movie databases. Also recommender systems have been used in the field of social networks [2]. Recommender systems use a database about user preferences to predict additional topics or products that a new user may like [3]. There are varieties of filtering approaches for recommender systems. The most prominent approach, which is actually used by many real online bookstores, is to take the behavior, opinions, and tastes of a large community of other users into account. These systems are often referred to as community based or collaborative approaches [4]. Collaborative filtering systems typically require three steps: first, to obtain user information (user entries for the evaluation of certain information, etc.); Second, analysis of the similarity between users, the formation of the recent neighbors; finally, is the resulting recommendations [5]. Collaborative filtering algorithms are divided into two main types memory-based and model-based. Memory-based algorithms, based on the total set of items rated by the user are predicted [6]. Model-based algorithms to predict the rate of learning models such as neural networks or Bayesian models are used [6]. Model-based collaborative filtering has been best method in recommender system [7]. The model-based approach privileges for learning a predictive model uses too. But memory based method directly uses user-item ratings for predicting the new item points [8].

Content based filtering method uses the item information. At its core, content-based recommendation is based on the availability of item descriptions and a profile that assigns importance to these characteristics. If we think again of the bookstore example, the possible characteristics of books might include the genre, the specific topic, or the author [4].

Knowledge based approaches are distinguished in that they have functional knowledge: they have knowledge about how a particular item meets a particular user need, and can therefore reason about the relationship between a need and a possible recommendation. The user profile can be any knowledge structure that supports this inference [9]. Two well-known techniques for knowledge based recommendations include: Interacting with constraint-based recommenders and Interacting with case-based recommenders [10].

Fig. 1 sketches a recommendation system as a black box that transforms input data into a ranked list of items as output. User models and contextual information, community and product data, and knowledge models constitute the potential types of recommendation input. However, none of the basic approaches is able to fully exploit all of these. Consequently, building hybrid systems that combine the strengths of different algorithms and models to overcome some of the aforementioned shortcomings and problems has become the target of recent research [4]. Various combination methods include: weighted methods, switching, mixed, Feature combination, Cascade, Feature augmentation, Meta-level [9].

Related work is referred in Section 2; the used models are described in Section 3. Section 4 described proposed approach and the proposed approach steps. In Section 5, dataset and preprocessing and experiment results are described. Section 6 discussed concludes of the article results.

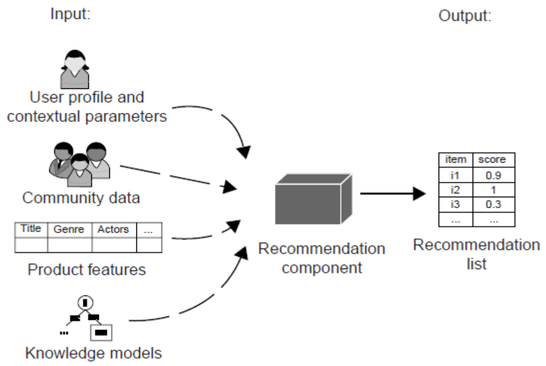

Figure 1. Recommender system as a black box[4]

2. RELATED WORK

Recommender systems have become an important research area in the mid-1990s [11]. Examples of researches in recommender systems include: [21], Group Lens [15], recommending books and other products at Amazon.com [12], MoviExplain [18], E-MRS [19], Fab [35], recommending news at VERSIFI Technologies [14], ORBIT [26].

Also Examples of hybrid recommender systems include: hybrid recommender system based on Multi-Layer Perceptron Neural Network with Collaborative filtering and Content-based filtering [16], [23], hybrid recommender system based on Naïve Bayes and item-based Collaborative filtering [22], hybrid recommender system by combining predictions using Collaborative filtering based on neighborhood and Demographic filtering and Content-based filtering [25]. In 2006 Hybrid Approach based on CF and Neural Network using movielens dataset was proposed [17]. In 2007 Web based movie recommender system was presented, which of the three techniques Demographic filtering, Content-based filtering, and Collaborative filtering has been used[20]. And also in 2011 recommender algorithm for mobile was presented [24].

3. BACKGROUND

A. Neural Networks

In this article using of multilayer perceptron neural network and spiking neural network for constructing model. Multilayer Perceptron network has been used in various domains until today, which do not explain. But Spiking Neural Network, as the third generation of neural networks has been considered [27]. According to research in Spiking Neural Networks, we can say that these networks as computationally are more powerful than other conventional neural networks [28]. And in solving problems require fewer neurons than other networks. The Error back propagation algorithms have been developed for Spiking Neural Networks [29]. A spiking neuron by sending an electric pulse to fire at a given time. These pulses are called action potentials or Spike. Spike is an amount of time that it is defined by the function [30].

Spiking Neural Network is shown in Fig. 2. The input layer of this network, defined by a collection of neurons called H. The input layer release Input spikes that reached in different time into middle layer. In the middle layer, a collection of neurons called I is defined.
Middle layer Spikes, released to the neurons in the output layer that is called J [31]. Neurons of each layer, with next layer are fully connected. Between neurons and other neurons in the next layer there are m connections. Each connection has a delay and a specific weight. This model is inspired by real neural tissue [32].

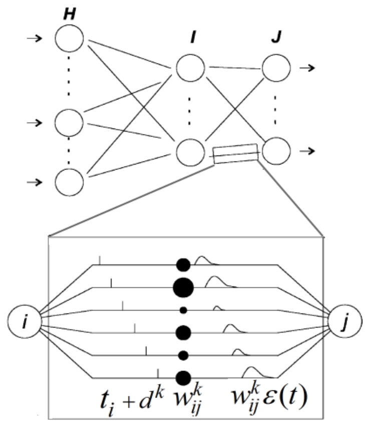

Figure 2. Spiking Neural Network and mode connections between neurons in this network[33]

B. Naïve Bayes

Naïve Bayes classifier using a probabilistic framework for solving classification problems is using. In the Naïve Bayes we have the following conditional probabilities:

$$P(C|A) = \frac{p(A,C)}{p(A)} \quad (1)$$

$$P(A|C) = \frac{p(A,C)}{p(C)} \quad (2)$$

According to Naïve Bayes the following equation holds true:

$$P(C|A) = \frac{p(A|C)P(C)}{p(A)} \quad (3)$$

An assumed record with collection features $(A_1A_2A_3 \ldots . A_n)$ Consider. Our goal is to calculate the batch this record. In fact of existing category we find that the probability of a set $p(c \mid A_1A_2A_3 \ldots . A_n)$ to maximize. First with previous formula calculated probabilities for all existing category. And then set the maximum value that can be considered as a new record category. According to the formula below the denominator is the same for all categories, so the goal is find a set to maximize relationships face.

$$P(C|A_1A_2A_3 \ldots . A_n) = \frac{p(A_1A_2A_3 \ldots A_n \mid C)P(C)}{p(A_1A_2A_3 \ldots A_n)} \quad (4)$$

C. Decision tree

Classification models based on decision tree the output knowledge of a decision tree, the attribute values are presented in different scenarios. Various methods for

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selecting features and the stop condition for the construction of decision trees that are actually numerous kinds of ways to build a decision tree based on the same theme.

4. THE PROPOSED HYBRID APPROACH

In this section, a new hybrid movie recommender system is presented, which increases the accuracy of the prediction will be achieved. In fact we created by combine multiple recommendations techniques to improve a movie recommender system. To the extent two techniques of collaborative filtering and content-based filtering can be combined using integrated hybrid scheme. Integrated hybrids a component unit of the proposer, the integrating different approaches formed by preprocessing and combines several sources of knowledge. Different types of data that will be applied to Recommender Systems are content based information and collaborative information. Content based information, described real data. In the area of movie, Content based data consist on styles (comedy, action,), actors name, release date, and more. Collaborative information including user comments in the data. For example, in the same area will be users rated of movies.

The recommender systems use the only collaborative information to find correlations between users and users target to suffer from problems. Therefore combination of methods is used. By using Integrated scheme combines collaborative filtering techniques and content based filtering. Proposed approach consists of two steps, clustering of samples, and the construct the model that is shown in Fig. 3. First, we clustered samples selected to be similar records in the same cluster. We used of classification models to build the model.

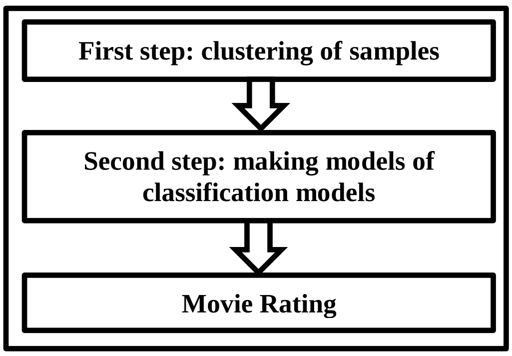

Figure 3. proposed hybrid approach

A. Clustering of samples

At this stage of the clustering algorithm we use k-Means. The main idea of in this algorithm is defined k for each cluster center. The goal of clustering is to assign each data sample to a cluster so that has the minimum distance to the center. Also average points belonging to each cluster considered as well as the cluster centers. Formula 1 is used to detect the degree of similarity.

$$d(x,y) = \sum_{i=1}^{n} \left| x_i - y_i \right| \quad (5)$$

In the formula, n is the number of features. Also x_i and y_i thus represents the I th features of x and y is two records.

B. Making models of classification models

At this stage, the clusters were created in the previous step, considered as the label classifier models. We used models classified to build the model. At this stage, the samples can be divided into two categories training set and test set. The number of samples in the training phase and the test will choose it correct to get better results. In general, different methods of data mining are classified to predict and descriptive. Prediction methods to predict of values of some attributes are used to specify the value of a property. Our goal at building model presented a model with high accuracy is proposed. In the proposed approach, we used prediction the nature of procedures and the monitoring and classification models. Our models are four classifiers models that include: Spiking Neural Network (SNN), Multi-Layer Perceptron neural network (MLP), Decision tree, Naïve Bayes. Procedure of the proposed approach is shown in Fig. 4. As shown in Fig. 4, the approach process includes extracting dataset, create a central data repository, preprocessing, clustering, data construct the model by using classification models, evaluation and interpretation of the model is that at this stage we examine the prediction accuracy.

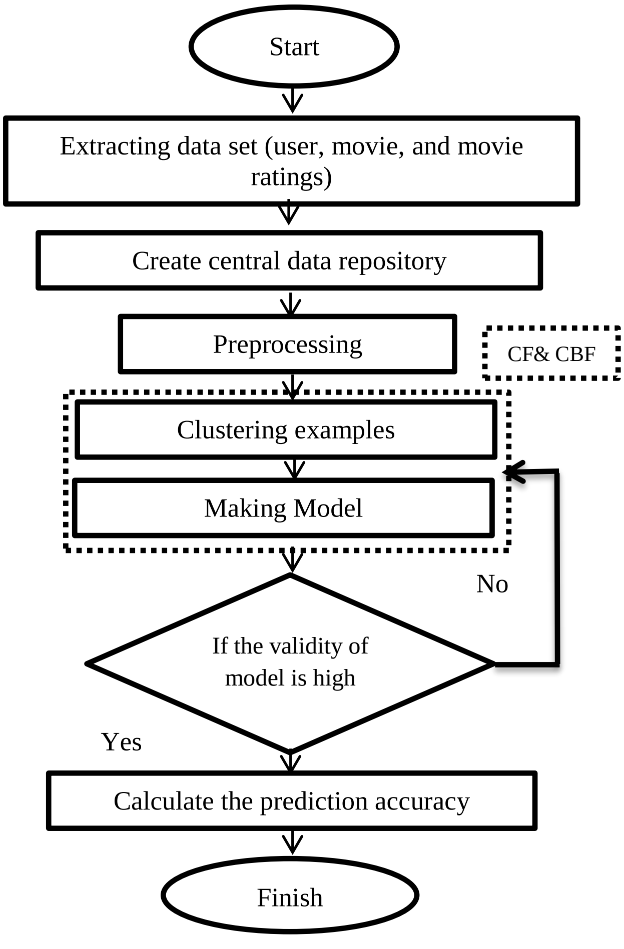

Figure 4. Stages of the proposed approach

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5. EXPERIMENTAL RESULT AND EVALUATION

A. MovieLens dataset

The Movielens dataset has been established by Lens research group from the University of Minnesota. This dataset is comprised of three types of datasets. Dataset used consisting of 100,000 ratings for 1682 movies and 943 users, which contains three sets of user data, video data, and ranking data.

B. preprocessing

In this article we used preprocessing operation before build models. Among is the most important coding, Feature subset selection, Data transformation, Sampling, Evaluate the correlation between features, Time coding based on Spiking patterns. After creating central data repository using three sets of user data and video data and rating data, we have a data matrix with 100,000 records that we applied the preprocessing steps on these data matrix. In Feature subset selection, we select important features. In Fig. 5 is shown the frequency of movie styles, which shows more movie style drama, comedy, action will be. That is why we selected 17 major styles of 19 Style movies. At the user Collaborative information, we select features such as user id, age, gender, occupation, and of information about movies, 17 type styles, and movie release Year, movie id, movies rating, timestamp. Then draw correlation matrix of features. Characteristics of Movielens dataset are not correlated with each other. In result we used of all features that we selected until this stage in model construction process. Conversion function applied for the attribute of user's occupation and attribute of user's age. Also been applied to the Spiking Neural Network input data, and output is converted into Spiking patterns.

After data preparation, data are clustered. We must select the appropriate number of clusters, in order that the data in different clusters of 10 teeth, 15 teeth, and 25 to 100 entries can be clustered. Then create the neural network model, by review and compare the accuracy of neural network models with different number of clusters, we divided data into 10 clusters. To build the model select 5,000 Record by random sampling.

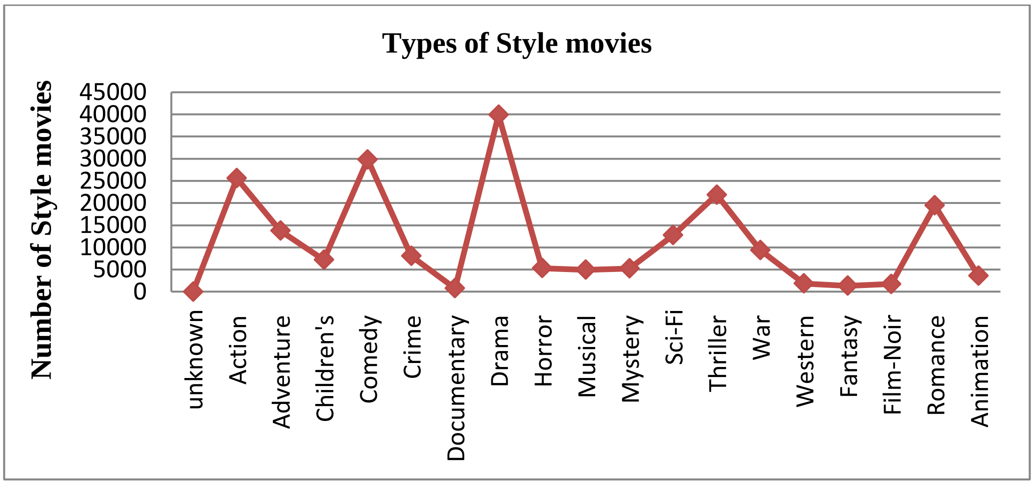

Figure 5. Variety of styles movie

C. Results of models

After preprocessing stage, we evaluate four models. To evaluate models for the training set 70% and for the tests the remaining 30% we consider. In Fig. 6 compares the results of the models is given according to classification error. By attention to fig. 6 can be expressed Multilayer Perceptron neural network model and a naive Bayes have smaller classification error than the other models. Fig. 7 shows compares models with classification error and prediction accuracy. Perceptron Neural Network Model and Naïve Bayes have higher prediction accuracy. Naïve Bayes model with prediction accuracy 99.8 % and classification error 0.2 % is the most appropriate model for the Movielens data.

6. CONCLUTION AND FUTURE WORK

In this article, new approach using the techniques of collaborative filtering and content based filtering in the movie hybrid recommender system is presented. The dataset used is movielens. Four models Spiking Neural Network (SNN), Multi-Layer Perceptron Neural Network (MLP), Decision tree, Naïve Bayes was presented. The four models evaluated with the prediction accuracy and classification error. Evaluating and comparing results of the four models, show improving in recommender systems.

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Spiking Neural Network was used for the first time in the field of recommender systems. The results show that this network is predicted in movie recommender system with 0.52 % classification error. Results show that the hybrid approach by attention to improve the weaknesses of single filtering methods is suitable for recommender systems. The results presented in this article using Multi-Layer Perceptron neural network prediction accuracy with 95.87 %, and Decision tree model with 92.61 %, and Naïve Bayes classifier with 99.83% Predictions to do. For improving recommender systems can be used hybrid different approaches, by combining approaches of collaborative filtering, and content based filtering, and demographic filtering, and knowledge based filtering. Also hybrid integration techniques, and parallel, and lines can be used. According to the new and simulations of brain with more realistic of spiking neural networks, this network can be used in various fields.

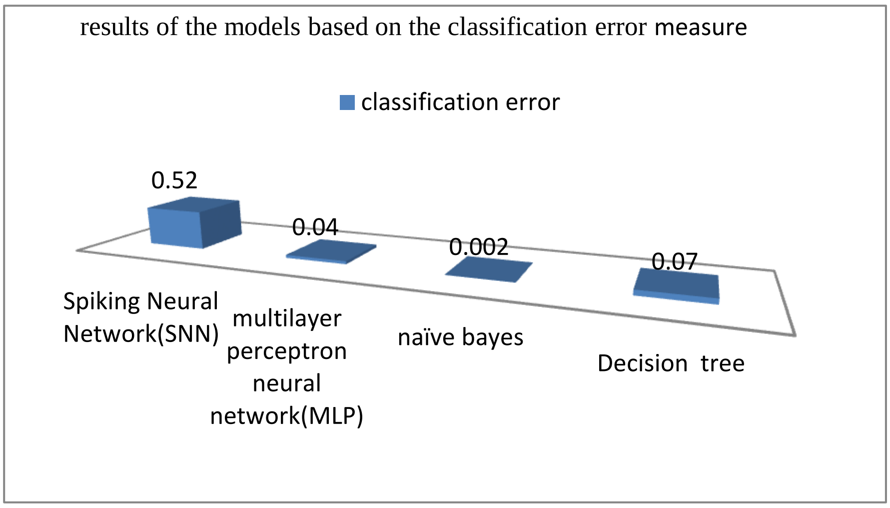

Figure 6. Results of the models based on the classification error measure

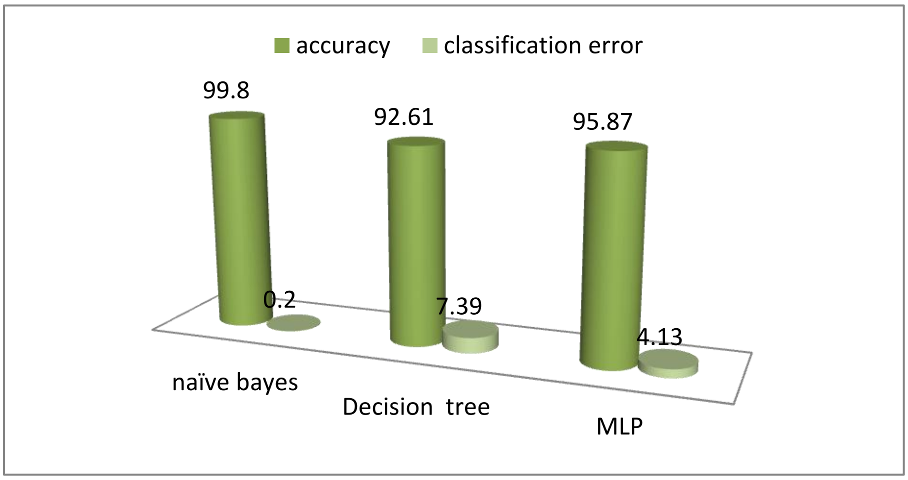

Figure 7. Results of the models with classification error and prediction accuracy

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REFERENCES

[1] L. Esmaeili, B. Minaei-Bidgoli, H. Alinejad-Rokny, M. Nasiri, "Hybrid recommender system for joining virtual communities," Journal of Applied Sciences Engineering and Technology, Vol. 5, pp. 500-509, 2012.

[2] B. Minaei-Bidgoli, L. Esmaeili, M. Nasiri, "Comparison of group recommendation techniques in social networks," I" ICCKE, pp. 236-241,2011.

[3] J.S. Breese, D. Heckerman, and C. Kadie, "Empirical Analysis of Predictive Algorithms for Collaborative Filtering," 14th Conf. Uncertainty in Artificial Intelligence, University of Wisconsin, madison, July 1998.

[4] D. Jannach, M. Zanker, A. Felfernig and G. Friedrich, "Recommender systems : an introduction," Printed in the United States of America, Cambridge University Press, 2011.

[5] Z. Zhang and S. Qian, "The Research of E-commerce Recommendation System Based on Collaborative Filtering Technology," Advances in CSIE, Vol. 1, AISC 168, Springer-Verlag Berlin Heidelberg, pp. 507–512, 2012.

[6] N. Shabib, M. Naemat-bahksh, M.S. Aghili-Dehkordi, "Use of recommender systems in e-commerce, E-Commerce National Conference," 2007.

[7] M. Nasiri, B. Minaei, and M. Rezghi, "Fuzzy dynamic tensor decomposition algorithm for recommender system," UCT Journal of Research in Science ,Engineering and Technology, University College of Takestan, Vol. 2, Issue 2, pp. 52-55, 2014.

[8] C. Desrosier, and G. Karypis, "A comprehensive survey of neighborhood-based recommendation methods," in Recommender Systems Handbook, Part 1, DOI: 10.1007/978-0-387-85820-3_4, pp. 107-144, 2011.

[9] R. Burke, "Hybrid Recommender Systems: Survey and Experiments," User Modeling and User-Adapted Interaction, Volume 12, Issue 4, pp 331-370, November 2002.

[10] A. Felfernig, R. Burke, "Constraint-based Recommender Systems: Technologies and Research Issues".10th Int. Conf. on Electronic Commerce (ICEC) '08 Innsbruck, Austria, ACM 978-1-60558-075-3/08/08, 2008.

[11] G. Adomavicius, and A. Tuzhilin, "Toward the Next Generation of Recommender Systems: A Survey of the State-of-the-Art and Possible Extensions," IEEE TRANSACTIONS ON KNOWLEDGE AND DATA ENGINEERING, VOL. 17, NO.6, pp734- 749, 2005.

[12] G. Linden, B. Smith, and J. York, "Amazon.com Recommendations Item-to-Item Collaborative Filtering," IEEE Internet Computing, Published by the IEEE Computer Society, pp. 76-82, 2003.

[13] B. N. Miller, I. Albert, S. K. Lam, J. A. Konstan, and J. Riedl, "MovieLens Unplugged: Experiences with an Occasionally Connected Recommender System," In Proceedings of the Conference on Intelligent User Interfaces, Florida, 2003.

[14] N. J.Belkin, and W.B. Croft, "Information filtering and information retrieval: Two sides of the same coin?," Communications of the ACM, vol. 35, no. 12, pp. 29-38, 1992.

[15] P. Resnick, N. Iacovou, M. Sushak, P. Bergstrom, and J. Riedl, "Group- Lens: An open architecture for collaborative filtering of netnews," In Proceedings of the 1994 Computer Supported Cooperative Work Conference, ACM, New York, 1994.

[16] C. Christakou, A. Stafylopatis, "A Hybrid Movie Recommender System Based on Neural Networks," International Conference on Intelligent Systems Design and Applications (ISDA'05), IEEE , 2005.

[17] C. Vassiliou, D. Stamoulis, and D. Martakos, "A Recommender System Framework combining Neural Networks & Collaborative Filtering," Proceedings of the 5th WSEAS Int. Conf. on Instrumentation, Measurement, Circuits and Systems, pp285-290, 2006.

[18] P. Symeonidis, A. Nanopoulos, and Y. Manolopoulos, "MoviExplain: A Recommender System with Explanations," Proceedings of the third ACM conference on Recommender systems, 317-320, 2006.

[19] A. T. Ho, and I. L. L. Menezes, and Y. Tagmouti, "E-MRS: Emotionbased movie recommender system," Proceedings of IADIS e-Commerce Conference. USA: University of Washington Bothell, 2006.

[20] N.T. Nguyen, M. Rakowski, M. Rusin, J. Sobecki, and L. C.Jain, "Hybrid Filtering Methods Applied in Web-Based Movie recommendation System," Knowledge-Based Intelligent Information and Engineering Systems, Australia, DOI 10.1007/978-3-540-74819-9_26, Volume 4692, pp 206-213, 2007.

[21] M. Montaner, B. Lopez, and J.P. de la Rosa, "A Taxonomy of Recommender Agents on the Interne," Artificial Intelligence Review 19, pp 285–330, 2003.

[22] M.A. Ghazanfar, and A. Prugel-Bennett, "An Improved Switching Hybrid Recommender System Using Naive Bayes Classifier and Collaborative Filtering," International MultiConference of Engineers and Computer Scientists, ISBN: 978-988-17012-8-2, Vol I, Hong Kong, 2010.

[23] Y. Deng, W. Zhonghai, C. Tang, H. Si, H. Xiong, and Z. Chen, "A Hybrid Movie Recommender Based on Ontology and Neural Networks," IEEE/ACM International Conference on Green Computing and Communications & International Conference on Cyber, Physical and Social Computing, China, 2010.

[24] S.K. Ko, S.M. Choi, H.S. Eom, J.W. Cha, H. Cho, L. Kim, and Y.S. Han, "A Smart Movie Recommendation System, " Human Interface, Part I, HCII 2011, LNCS 6771, Springer-Verlag Berlin Heidelberg, pp. 558–566, 2011.

[25] B. Chikhaoui, M. Chiazzaro, and SH. Wang, "An Improved Hybrid Recommender System by Combining Predictions," 25th IEEE International Conference on Advanced Information Networking and Applications Workshops, Biopolis, Singapore, 2011.

[26] D. Pathak, S. Matharia, and C.N.S. Murthy, "ORBIT: HYBRID MOVIE RECOMMENDATION ENGINE," IEEE International Conference on Emerging Trends in Computing, Communication and Nanotechnology, DOI: 10.1109/ICE-CCN.2013.6528589 , Tirunelveli, 2013.

[27] W. Maass, "Networks of spiking neurons: the third generation of neural network models", Neural Networks, Vol. 10, pp.1659-1671,1997.

[28] W. Maass, "Computing with spikes", Special Issue on Foundation of Information Processing of TELEMATIK, pp. 32-36, 2002.

[29] S. Bohte,M. Kok, H. Poutre, "Error back propagation in temporally encoded networks of spiking neurons", Neurocomputing, Vol.48, pp.17-37, 2002.

[30] J. Xin, J. Embrechts, "Supervised Learning with Spiking Neural Networks", Proceeding of International Joint Conference on Neural Networks (IJCNN), pp 1772-1777, 2001.

[31] S. Bohte, "Spiking Neural Networks", Ph.D. dissertation, Center for Mathematics and Computer Science (CWI), Amesterdam, 2003.

[32] M. Hermans, B. Schrauwen, M. D'Haene, "Biologically inspired features in spiking neural networks",19th Annual Workshop on Circuits, Systems and Signal Processing, pp. 328-334, 2008.

[33] S. M. Bohte, "SPIKING NEURAL NETWORKS",Thesis Universiteit Leiden, 1974.

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Virtualization and live migration in VirtualBox

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***Abstract*—Virtualization is a very efficient mechanism that has improved machines use. This technique has been implemented in many systems and it helps utilize a single physical machine to run different operating systems simultaneously. Another benefit of virtualization is Live Migration. Such feature allows us to move virtual machines to different hosts easily. In this article I will install different operating systems in my laptop and try to migrate them to another computer to share data in a short amount of time.**

Keywords: ***virtualization; teleportation; virtual machine; hypervisor; live migration;***

1. INTRODUCTION

The necessity of virtualization is very early since 60's. Nowadays the term virtualization has gone into a new level and it is used a lot.

Virtualization definition in computing refers to the act of creating a virtual (rather than actual) version of something, including but not limited to a virtual computer hardware platform, operating systems, storage devices or network resources[1].

Without the virtualization a physical host cannot run multiple operating systems simultaneously. To create a virtual machine is used a software called hypervisor. Hypervisor acts like some kind of manager for virtual machines.

Due to importance of virtualization nowadays hypervisors are very advanced. Even today's operating systems like windows 8 have build in hypervisors Hyper V. Other well known hypervisors are VMware ESX and ESXi, Citrix XEN and Oracle VM. Each one of these hypervisors offer a feature called teleportation or Live Migration. Through Live Migration we can move a virtual machine from a physical host to another with not much effort.

2. VIRTUALIZATION BENEFITS

Virtual machines have many benefits[2].

- ***Reduce the number of machines***: by converting a single physical machine that runs with multiple systems inside, there are not needed many computers to do this.
- ***Increase the efficiency***: the computers will be more efficient by using many operating systems inside that support different software 00components if needed.
- ***Faster development:*** virtualization made possible an incredibly fast development of test environments. Even in error cases not everything is lost so the virtual test environment is the best one.
- ***Simple management:*** in a single machine you can manage many systems and all their components. VMware lets you administer both virtual and physical machine simultaneously .
- ***Reduce the costs***: by virtualizing you do not need to buy many servers. In a single server

you can virtualize many systems so the heat produced by the servers is reduced, and all the process costs less.

3. RELATED WORKS

Many articles and experiments have been made in virtualization and migration field and many authors have studied different features of these.[4] In these articles they have estimated the performance, installation, the advantages and different options. A lot of authors have studied the performance of the virtual machines by measuring the time of the response for an operation that has been asked to do.
Other articles have in live migration filed except creating a migration environment and analyzing the benefits of migration there are estimated also the downtime and the total migration time.[3]
With all these articles and research made in this field I still haven't made clear the reason:

Why is live migration used?

In most of big companies live migration is used to manage servers in a simple way. By transporting virtual machines such easily server maintenance doesn't cost too much in time and availability point of view.
Another big benefit of live migration is managing load balance in servers. When a server is overloaded a quick load migration into another server does a pretty good balance.

But in home conditions like my case only benefit of performing it is sharing data simply especially when u have different operating systems that cannot perform simple sharing data by using a home network.

4. ENVIRONMENT OF THE EXPERIMENT

The experiment is realized in two computers running Windows 7 with the same CPU family: dual core and core 2 duo, and that are in the same network. The computers RAM are respectively 6 GB and 4GB.

5. THEORY OF THE EXPERIMENT

In this paper I will try to perform a live migration of a virtual machine using as hypervisor Virtual Box and see how much time it will require and see CPU consumption and memory used. Virtual Box from Oracle is a desktop hypervisor and it does not require a server to install virtual machines and perform live migration. But live migration in Virtual Box requires a shared storage between source computer and host computer. Also it is required that these two computer need to be in same network.

Since I do not have a shared storage between my two computers I will be creating it virtualy. To create this I will need a software called FreeNas to make ISCSI disks. FreeNas is a simple BSD OS that will help me create a shared storage between my 2 computers to perform the teleportation.

After installing FreeNas in a VM I configure its LAN and give it an ipv4 address 192.168.1.250:80 so it can communicate with host computer or other virtual machines that will need ISCSI disks. I make sure this communication is not blocked by any firewall by pinging it frorm FreeNas shell.

Than we access the web GUI of FreeNas from a simple web browser from host computer or any other VM that holds a OS and configure the disks of FreeNas VM. I will create one ISCSI disk at size of 10 GB in order to install guest OS in other VM.

After the disks are created we need to add them to VirtualBox hard drives. I do this by executing a script in CMD that will attach ISCSI disks to VirtualBox HDD.

VBoxManage attachiscsidisk –server 192.168.1.250 –iqn.2007-09.jp.ne.peach.istgt:auroradisk

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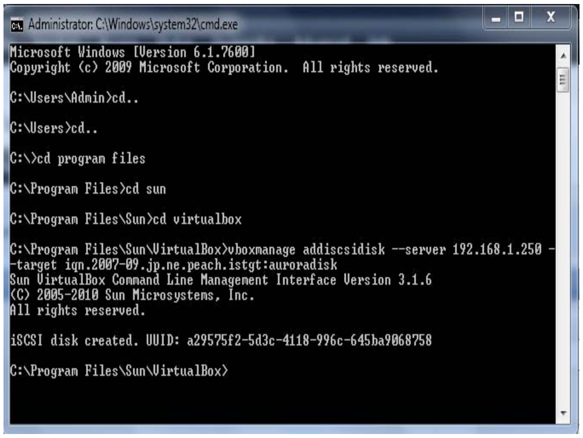

Figure 1. Script execution

After this command we see in:

File -> Virtual Media Manager ->Hard Disks

that a new disk is added not more .vdi but .iscsi and not attached to any virtual machine created. Now I will create a new virtual machine and not create a new hdd but use the disk .iscsi created before. I will install Ubuntu 10.04 as guest OS. These things will be performed in source computer.

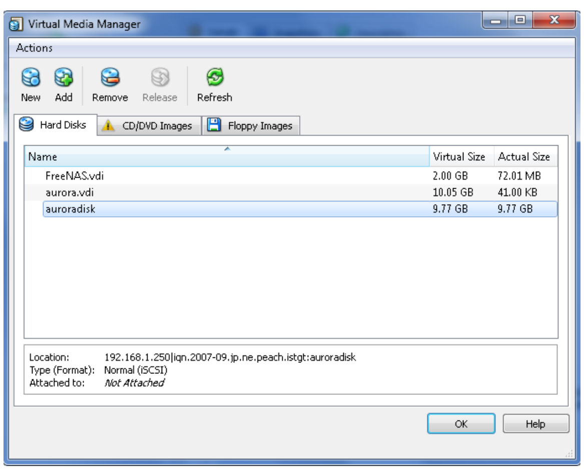

Figure 2. New disk added

In destination computer we create another virtual machine with the same settings as the virtual machine in souce computer and select as hdd shared disk (in order to attach the shared disk to virtualbox in destionation computer I perform the

VBoxManage attachiscsidisk –server 192.168.1.250 – iqn.2007-09.jp.ne.peach.istgt:auroradisk)

that we installed Ubuntu guest OS in source computer. But in destination computer we will not install anything. Now the virtual machine is ready to be teleported.

6. EXPERIMENT

Now that I have prepared the environment for the expertiment I will perform the teleportation and measure the time that it requires the CPU and memory consumption. First I prepare the target machine created before to wait for a incoming VM. I do this by performing this command in cmd. **VBoxManage modifyvm ubuntu2_aurora –-teleporter on –teleporterport -1234** (*we can use a port whatever we want*).

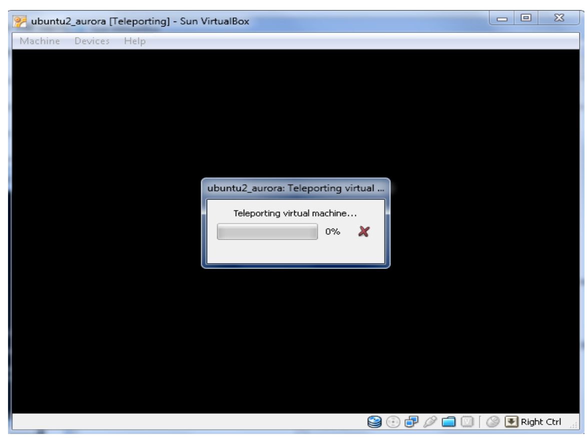

Figure 3. Starting the teleportation

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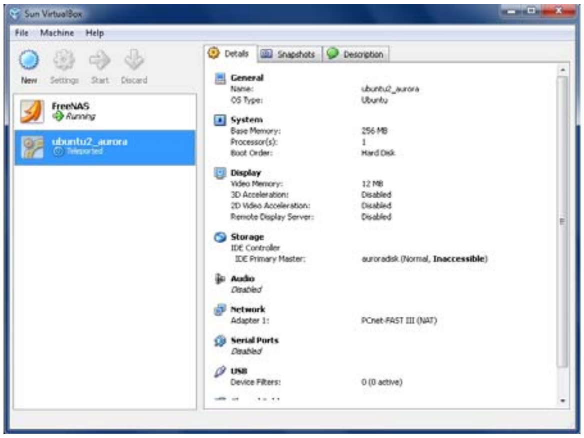

Figure 4: Virtual machine teleported

On source computer I turn on the virtual machine ubuntu1_aurora and perform this command.

VBoxManage controlvm ubuntu1 teleport --host 192.168.1.3 --port 1234

Now a bar is shown in cmd and telling us in decimal digits how percent the teleportation is completed. In this moment we measure the cpu and memory usage of this process in source computer on Task Manager. I will measure the time needed to perform this teleportation.

On my expectation it should not take to much time because we are using a shared storage and VM's data are in shared storage and only the configuration files are teleported. I will perform this test a few times to get a correct result.

7. RESULTS

The first time I tried the experiment I was using a Pentium 4 instead of Dual Core and cpu and ram went 100% on source computer leading to a deadlock because we had a "CPU time mismatch error".

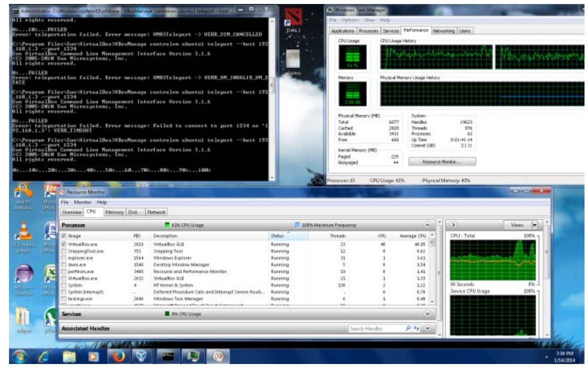

Figure 5: CPU used during the experiment (deadlock CPU missmatch)

Than i tried it in another computer and it worked correctly.

The machine is teleported and in the destination computer it is in the same state as it was before. In the second teleportation I created a file .txt in source computer and type some words.

When teleport is completed we see in destination computer that the file is opened as well with words in it. It took approximately 7s to complete the teleportation. I performed it 2 other times to compare the result.

Table 1: Cpu consumption and Ram used

Teleportation	1	2	3
Time (s)	7.1	8.1	7.7
Cpu (%)	2.1	2.2	2.1
Memory private (kB)	41.241	42.133	40.175

8. CONCLUSIONS

Live migration is a very useful and effective technique which has improved a lot server management and maintenance. Even in this simple experiment I have demonstrated:

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- An easy way to migrate virtual machines using VirtualBox hypervisor
- The teloprtation of virtual machines is performed in the minimal amount of time
- The machine teleported in destination is the same as it was in source computer
- This simple technique of migration can be executed several times and we also can measure and evaluate every time CPU and RAM used during the teleportation

9. FUTURE WORKS

Virtualization and live migration are very efficient technologies commonly used today and in the future they will be implemented even in in many and many systems. Other software components may be developed and installed to perform easily and faster live migration between two or more machines.

10. REFERENCES

[1] Wikipedia literature: http://en.wikipedia.org/wiki/Virtualization

[2] Virtualization technology in the enterprise. *Available:* http://software.intel.com/en-us/articles/the-advantages-of-using-virtualization-technology-in-the-enterprise

[3]http://wccclab.cs.nchu.edu.tw/www/images/Data_Center_Network/9.pdf

[4] "Virtual Machines: Virtualization ". Retrieved 2011-03-11.

[6] Live migration of multiple virtual machines – Internation conference of Cloud Computing

[7]http://www.vmware.com/virtualization/virtualization-basics/virtualization-benefits.html

[8]http://www.nec.com/en/global/solutions/servervirtualization/merit.html

[9] http://www.sysprobs.com/setup-test-virtualbox-teleportation-normal-pc-live-migration-virtual-machines

[10]https://blogs.oracle.com/vreality/entry/teleporting

http://sites.google.com/site/ijcsis/
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Study the Performance of Fountain Codes in Wireless Communication Systems

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Abstract

In wireless, satellite, and space communication systems reducing error is critical. High bit error rates of the wireless communication system require employing various coding methods on the data transferred**.** To address the large latency and degraded network throughput due to the retransmission triggered by frame loss in high speed wireless networks, the purpose of this paper is to study and investigate the performance of fountain codes that is used to encode and decode the data stream in digital communication. This solution intelligently encodes a number of redundant frames from original frames upon link loss rate so that a receiver can effectively recover lost original frames without significant retransmissions. Since then, many digital Fountain coding methods have been invented such as Tornado codes, Luby transform (LT) codes and Raptor codes.

Keywords: wireless communication systems, fountain codes, Tornado codes, Luby transform, Raptor codes

1. Introduction

Wireless networking technologies have been widely deployed in civil and military applications such as 3G/4G and IEEE 802.11 WLAN networks. However, wireless communication suffers from frame losses due to channel fading, shadowing, mobility and transmission collisions (interferences). Frame loss significantly undermines wireless network performance in that 1) latency is enlarged and 2) throughput is degraded. The large latency is incurred by the retransmission of lost frames in the MAC layer that is part of most MAC protocols for reliable link layer point-to-point transmission [6].

On the Internet, data is transmitted in the form of packets. Each packet is equipped with a header that describes the source and the destination of the packet, and often also a sequence number describing the absolute or relative position of the packet within a given stream. These packets are routed on the network from the sender to the receiver[16]. Due to various reasons, for example buffer overflows at the intermediate routers, some packets may get lost and never reach their destination. Other packets may be declared as lost if the internal checksum of the packet does not match. Therefore, the Internet is a very good real-world model of the BEC.

Reliable transmission of data over the Internet has been the subject of much research. For the most part, reliability is guaranteed by use of appropriate protocols. For example, the ubiquitous TCP/IP ensures reliability by essentially retransmitting packets within a transmission window whose reception has not been acknowledged by the receiver (or packets for which the receiver has explicitly sent a negative acknowledgment). It is well known that such protocols exhibit poor behavior in many cases, such as transmission of data from one server to multiple receivers, or

transmission of data over heavily impaired channels, such as poor wireless or satellite links. Moreover, ack-based protocols such as TCP perform poorly when the distance between the sender and the receiver is long, since large distances lead to idle times during which the sender waits for an acknowledgment and cannot send data. For these reasons, other transmission solutions have been proposed. One class of such solutions is based on coding. The original data is encoded using some linear erasure correcting code. If during the transmission some part of the data is lost, then it is possible to recover the lost data using erasure correcting algorithms. For applications it is crucial that the codes used are capable of correcting as many erasures as possible, and it is also crucial that the encoding and decoding algorithms for these codes are very fast.

Reed–Solomon codes can be used to partially compensate for the inefficiency of random codes. Reed–Solomon codes can be decoded from a block with the maximum possible number of erasures in time quadratic in the dimension. (There are faster algorithms based on fast polynomial arithmetic, but these algorithms are often too complicated in practice.) However, quadratic running times are still too large for many applications.

In [16, 18], the authors construct codes with linear time encoding and decoding algorithms that can come arbitrarily close to the capacity of the BEC. These codes, called Tornado codes, are very similar to Gallager's low-density parity-check (LDPC) codes [19], but they use a highly irregular weight distribution for the underlying graphs.

Fountain codes are ideally suited for transmitting information over computer networks. A server sending data to many recipients can implement a Fountain code for a given piece of data to generate a potentially infinite stream of packets. As soon as a receiver requests data, the packets are copied and forwarded to the recipient. In a broadcast transmission model there is no need for copying the data since any outgoing packet is receive by all the receivers. In other types of networks, the copying can be done actively by the sender, or it can be done by the network, for example if multicast is enabled. The recipient collects the output symbols, and leaves the transmission as soon as it has received of them. At that time it uses the decoding algorithm to recover the original symbols. Note that the number is the same regardless of the channel characteristics between the ender and the receiver. More loss of symbols just translates to longer waiting time to receive the packets. If can be chosen to be arbitrarily close to , then the corresponding Fountain code has a universality property in the sense that it operates close to capacity for *any* erasure channel with erasure probability less than 1.

This paper reviews the channel coding methods in the physical layer and Digital Fountain coding proposals in the application layer. The paper is organized as follows. Section 2 discusses the RS codes architectures, applications and limitations. Section 3 presents the fountain codes properties, the related erasure channel and construction. Section 4 Recent advances have produced powerful fountain codes, such as Luby Transform (LT) codes , Tornado codes and Raptor codes. Finally, the conclusion is presented in section 5.

2. Developing Background Related Workand Motivations

2.1. Error correction control (ECC)

Coding techniques are used in communication system to improve the reliability and efficiency of the communication channel. The reliability is commonly expressed in statical terms such as the probability of receiving the wrong information, that is, information that differs from what was originally transmitted. Error control is concerned with techniques of delivering information from a

source (sender) to a destination (the receiver) with a minimum of errors. In a digital audio recorder system, the sound signal is digitized in the form of (binary) symbols. In order to make it possible to reliably record the digital data, the data are, prior to recording, translated in two successive steps (a) error correcting code and (b) recording code. The output generated by the recording code is stored on the storage medium in the form of binary physical quantities.

Error correction control is realized by adding extra symbols to the conveyed message. These extra symbols make it possible for the receiver to detect and /or correct some of the errors that may occur in the retrieved message. The main challenge is to achieve the required protection against the inevitable transmission errors without paying too high a price in adding extra symbols. There are many different families of error-correcting codes of major importance for recording applications is the family of Reed-Solomon (RS) codes.

2.2. Binary Erasure Channel

The Binary Erasure Channel (BEC) is a channel model where the receiver either receives the transmitted bit or is informed with the erasure of the bit, that is, the bit was not received or erased. Therefore, the receiver has no idea about the transmitted bit with a certain probability *p,* and is exactly sure about the transmitted bit with a certain probability 1-*p*.According to Shannon, the capacity of BEC is 1-*p,* which means that for the alphabet size of 2^k , where k is the number of bits in the alphabet, no more than $(1-\ p)\ k$ bits/symbol can be reliably communicated over the binary erasure channel[20].

Additionally, any feedback from the receiver to the transmitter will not increase the capacity of the channel and reliable communication should be possible at this rate. Automatic Repeat Request (ARQ) schemes have so long been used as a classical approach to solve the reliable communication problem. However, excessive number of feedbacks used in the case of erasures causes wasteful usage of bandwidth, network overloads and intolerable delays. Also known as rateless erasure codes are a class of erasure codes with the property that a potentially limitless sequence of encoding symbols can be generated from a given set of source symbols such that the original source symbols can ideally be recovered from any subset of the encoding symbols of size equal to or only slightly larger than the number of source symbols. The term fountain or rateless refers to the fact that these codes do not exhibit a fixed code rate.

2.3. Reed-Solomon code

A Reed-Solomon (RS) code is an error-correcting code first described in a paper by Reed and Solomon I 1960 [1].RS encoding data is relatively straightforward, but decoding is time-consuming, despite major efficiency improvements made by Berlekamp and other during the 1960's. Only in the past few years has it become computationally possible to send high-bandwidth data using RS.

RS codes are non-binary cyclic error-correcting codes. The RS encoder takes a block of digital data and adds extra bits. While the errors occur during transmission or storage, the RS decoder processes each block and attempts to correct errors and recover the original data. The number and type of errors that can be corrected depends on the characteristics of the RS code.

2.3.1. Encoding Of RS Codes

The basic structure of RS code as shown in Figure 1 represented that the codeword symbols (*n*) is unite of two segments information symbols (*k*) and parity symbols (*2t*). The information symbols (*k*) is having message that is to be transmitted and parity symbols (*2t*) is the redundancy added to message to transmit it from source to destination without error [7] i.e., noise.

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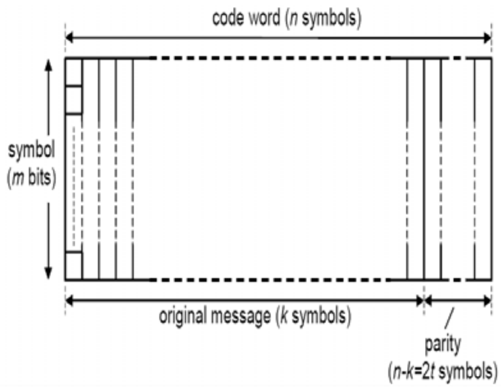

Figure (1): Encoding of RS codes

Reed-Solomon codes are nonbinary cycliccodes with symbols made up of m-bit sequences, where m is any positive integer having a value greater than 2. R-S (n, k) codes on m-bit symbols exist for all n and k for which

$$0 < k < n < 2^m + 2 \quad (1)$$

Where k is the number of data symbols being encoded, and n is the total number of code symbols in the encoded block. For the most conventional R-S (n, k) code,

$$(n, k) = (2^m - 1, 2^m - 1 - 2t) \quad (2)$$

Where t is the symbol-error correcting capability of the code, and $n - k = 2t$ is the number of parity symbols. An extended R-S code can be made up with $n = 2^m$ or $n = 2^m + 1$.

Reed-Solomon codes achieve the largest possible code minimum distance for any linear code with the same encoder input and output block lengths. For nonbinary codes, the distance between two code words is defined (analogous to Hamming distance) as the number of symbols in which the sequences differ. For Reed- Solomon codes, the code minimum distance is given by

$$d_{min} = n - k + 1 \quad (3)$$

The code is capable of correcting any combination of t or fewer errors, where t can be expressed as [3]:

$$t = \left\lfloor \frac{d_{min}-1}{2} \right\rfloor = \left\lfloor \frac{n-k}{2} \right\rfloor \quad (4)$$

RS differs from a Hamming code in that it encodes groups of bits instead of one bit at a time. We will call these groups \digits" (also \symbols" or \coefficients"). A digit is error-free if and only if all of its bits are error-free.

Classical coding scheme for recovering erasures are Reed-Solomon codes [1, 3] employed in a variety of commercial applications, most notably in data storage as a key component of compact disks. In coding theory, Reed-Solomon codes are an example of Maximum Distance Separable (MDS) codes which achieve the Singleton bound [4]. Maximum distance separable (MDS) codes are practical codes that achieve the capacity of the erasure channel. A *(n, k, d)* MDS code, has a property that any k coordinates constitute an information set [2]. A receiver that receives any k symbols from a total of n symbols in each codeword can reconstruct the original message, provided it knows the position of the k received symbols. Reed Solomon (RS) codes are the most well-known MDS codes. These can be decoded in time O ($K2$), using algebraic methods such as list decoding.

2.3.2. Decoding Of RS Codes

The RS decoder consists of two main stages; error detection stage, and error correction stage as shown in figure (2) [15]. Firstly, a serial syndrome is used to checks if this codeword is a valid codeword or not. If errors occurred during transmission, the decoder carried out error detection, then tray to correct these errors. Secondly, the key equation solver is used as decoding algorithm to find the coefficients of error-location polynomial σ(x) and error-evaluator

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polynomial W(x). Thirdly, the Chien search block which is used to find the roots of σ(x) which present the inverse of the error locations. Fourthly, the Forney algorithm block is used to find the values of the errors. Finally, after getting the values and locations of the error, the received codeword can be corrected by XOR-ing the received vector with the error vector.

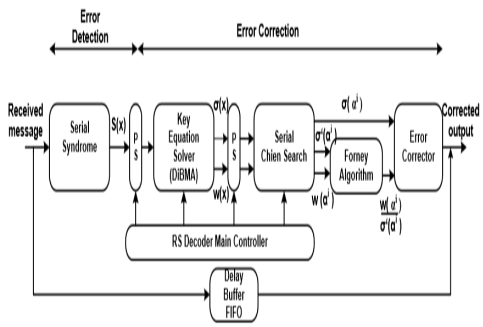

Figure (2): RS decoder

2.3.3. Reed-Solomon Codes applications

In particular, Reed-Solomon codes are the most frequently used digital error control codes in the world, due their usage in computer memory and non-volatile memory applications. A hurried list of significant applications includes the Digital Audio Disk, Deep Space Telecommunication Systems, Error Control for Systems with Feedback, Spread-Spectrum Systems, and Computer Memory [8].

2.3.4. Reed-Solomon Codes limitations

Despite their popularity, RS codes are not suitable for bulk data distribution over the internet. The quadratic decoding time is unacceptable when data rates are of the order of Mbps [2]. Furthermore, typical RS code implementations have small block lengths such as the NASA standard (255; 233; 33) code over *F*256. This requires a large file to be segmented into many small blocks before transmission. Finally, since RS codes are block codes, they need to be designed for a specific rate. This requires that we need to estimate the erasure probability of the channel beforehand. This is clearly not possible when multiple clients over different quality of channels are being served simultaneously.

3. Fountain codes

A fountain code is a forward-error-controlcode that can produce as many redundant packets as needed for packet erasure correction. Unlike automatic-repeat-request (ARQ) transmission, fountain coding does not require the destination to inform the source of the identities of the packets that are erased or even keep track of which packets are erased. We examine the use of fountain coding for both unicast and multicast transmission in packet radio systems, where communication takes place over time-varying channels with fading, shadowing, and other types of propagation losses.

In [16], Shokrollahi states, A decoding algorithm for a Fountain code is an algorithm which can recover the original k input symbols from any set of n output symbols with high probability. For good Fountain codes the value of n is very close to k, Note that the number n is the same regardless of the channel characteristics between the sender and the receiver. More loss of symbols just translates to a longer waiting time to receive the n packets." Thus, for noisy wireless channels, the waiting time, and consequently the overall throughput performance of the fountain coding system, depends heavily on the selection of the channel code and the modulation format usedto transmit the wireless signals.

Proposed for wireless mesh networks by Katti, et al. not only forwards the packets but also mixes packets from different sources into a single transmission and decomposes the packets at the receiver. In upper layers, a coding concept called Digital Fountain has been introduced in 1998 by Byers, et al to generate a stream of packets, including some redundant packets, like in water fountain to address potential packet loss in

multicast applications that do not allow retransmission. Since then, many Digital Fountain coding methods have been invented such as Luby transform codes (LT codes) and Raptor codes.
Consider a setting where a large file is disseminated to a wide audience who may want to access it at various times and have transmission links of different quality. Current networks use unicast-based protocols such as the transport control protocol (TCP), which requires a transmitter to continually send the same packet until acknowledged by the receiver. It can easily be seen that this architecture does not scale well when many users access a server concurrently and is extremely inefficient when the information transmitted is always the same. In effect, TCP and other unicast protocols place strong importance on the ordering of packets to simplify coding at the expense of increased traffic.

3.1. Digital fountain codes

The digital fountain was devised as the ideal protocol for transmission of a single file to many users who may have different access times and channel fidelity. The name is drawn from an analogy to water fountains, where many can fill their cups with water at any time. The output Packets of digital fountains must be universal like drops of water and hence be useful independent of time or the state of a user's channel [12, 13].
As show in Figure (3) the encoder of fountain codes is like a fountain spewing. Infinite coded symbols can be produced. Source data is divided into k input symbols of size l. With fountain codes, the k input symbols are combined into infinite encoding symbols at source. All k input symbols can be recovered from any set of $(1+ \varepsilon) k$ encoding symbols, where $0< \varepsilon<1$. Encoder of fountain codes is bit rate independent which is not limited by the size of the source data and can generate an unlimited number of encoding symbols.

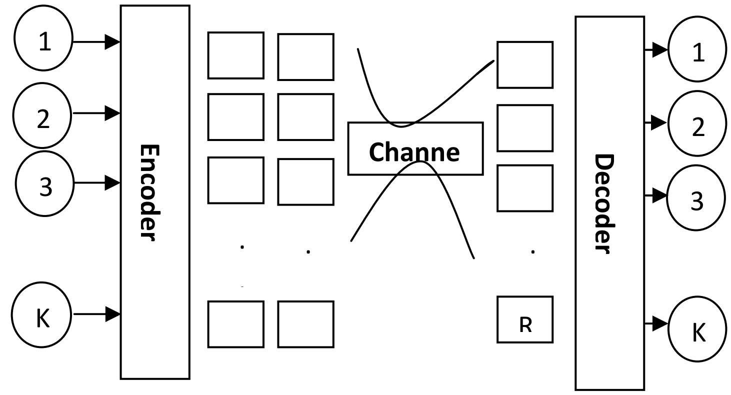

Figure (3): Fountain code

3.2.Fountain codes properties

Consider a file that can be split into k packets or information symbols and must be encoded for a BEC. A digital fountain that transmits this file should have the following properties:
1. It can generate an endless supply of encoding packets with constant encoding cost per packet in terms of time or arithmetic operations.
2. A user can reconstruct the file using any k packets with constant decoding cost per packet, meaning the decoding is linear in k.
3. The space needed to store any data during encoding and decoding is linear in k.
These properties show digital fountains are as reliable and efficient as TCP systems, but also universal and tolerant, properties desired in networks.

3.4. Fountain Code Construction Outline

Fountain Codes are a new class of codes designed and ideally suited for reliable transmission of data over an erasure channel with unknown erasure probability. The encoder can produce potentially infinite number of output symbols. Output symbols can be bits or more general bit sequences. However, random linear Fountain Codes have encoding complexity of $O\ (N^2)$ and

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decoding complexity of O (N^3) which makes them impractical for nowadays applications.

The fountain code constructions we provide all have the property that encoded symbols are generated independently of one another. In addition, we will assume that the set of received encoded symbols is independent of the values of the encoded symbols in that set, an assumption that is often true in practice. These assumptions imply that for a given value of *k*, the probability of decoding failure is independent of the pattern of which encoded symbols are received and only depends on how many encoded symbols are received.

3.4.1. Fountain Coding

A fountain code is optimal if the original k source symbols can be recovered from any k encoding symbols. Fountain codes are known that have efficient encoding and decoding algorithms and that allow the recovery of the original k source symbols from any k’ of the encoding symbols with high probability, where k’ is just slightly larger than k.

Digital fountains have changed the standard transmission paradigm. A digital fountain can encode and transmit an unlimited number of data packets until every user gets enough information to guarantee correct decoding. Multimedia broadcasting, emerging peer-to-peer applications are only two examples of many other scenarios where digital fountains can be successfully applied.

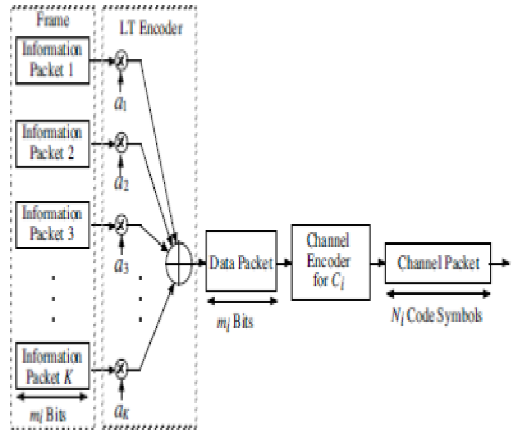

Figure (4): Fountain code

As shown in Figure (4) [17]: Consider a file that can be split into k packets or information symbols and must be encoded for a BEC. Regardless of the erasure probability, Fountain Codes are near optimal for all BEC. Therefore, on the BEC, Fountain Codes are called *universal* codes. a message consists of *k*k* bits and each drop contains *k* bits.

Whoever collects any $K' \geq K$ number of *k* bits, where K ' is slightly larger than K, can recover the original message with high probability.

Fountain Codes can be implemented at random with an average degree of k / 2. Here, the degree is the number of ones divided by the total number of bits in the generator matrix. The average degree of the generator matrix determines the complexity of encoding and decoding process. The higher the degree, the higher the complexity at the transmitter and receiver side and the more successful the receiver is in the decoding phase. Let us assume that we transmit *k* source symbols *k* *s*, *s*, *s*... *s* 1 2 3 with a random generator matrix of degree k / 2. The encoding process of Fountain Codes is given by the following equation [9]:

$$t_n = \sum_{k=1}^{k} s_k G_{kn} \qquad (5)$$

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Where t_n indicates the transmitted symbols. G_{kn} Can be generated at the transmitter side pseudo-randomly with a random seed, namely by a key, and transmitted to the receiver causing an extra overhead cost. As long as the symbol size is much larger than the key size, this overhead is neglectable. One other way to produce a unique G_{nk} is to synchronize the receiver and the transmitter with same clock pulses and to use deterministic random number generators at both sides.

3.4.2. Fountain decoding

The decoding process of Fountain Codes is given as:

$$s_k = \sum_{n=1}^{k} t_n G_{nk}^{-1} \quad (6)$$

In order for a *k*k G* matrix to be invertible, each row should be linearly independent from the others. The probability that the first row is not an all zero row is 1-2^{-k} , the probability that the second row is neither all zero nor same with the first row is $1-2^{-k+i}$. Iterating until *K*, we get as the overall success rate:

$$1-\delta=\prod_{i=0}^{k-1}(1-2^{-k+i}) \qquad (7)$$

1−δ is lower bounded by 0.289 for *k* >10. For any *NxK* binary matrix to be invertible, δ is upper bounded by $2^{-(N-K)}$. Accordingly, each additional row increases the success probability drastically. Thus, as the message size increases, random Fountain Codes come arbitrarily close to the channel capacity. Despite a very small overhead and rate erasure independency, random Fountain Codes have a quadratic encoding complexity, *k* bits times the degree *k*/2, and cubic decoding complexity ~$2K^3/3$. This makes them far away from most of the applications such as mobile broadcasting, where only a limited processor power can be used at the receiver side. Since then, many digital Fountain coding methods have been invented such as Luby transform codes (LT codes), Tornado codes and Raptor codes.

4. Fountain coding Methods

4.1. LT code

4.1.1. Introduction

Luby proposed LT codes which is the first implementation of digital fountain codes in 2002. Luby Transform (LT) codes have been proposed by Michael Luby to reduce the encoding and decoding complexity of random linear Fountain Codes while maintaining the small overhead. With a good choice of degree distribution, i.e. the distributions of the edges in the Tanner graph, LT codes can come arbitrarily close to channel capacity with certain decoder reliability and logarithmically increasing encoding and decoding costs.
With LT codes, data was divided into fix size blocks. Each block is divided into fix size symbols. So the number of input symbols is fixed. Infinite coded symbols can be generated by encoder of LT codes. All input symbols can be recovered by decoder in LT codes when number of encoding symbols are received slightly larger than number of input symbols.

In order to reduce the complexity even more, we can decrease the reliability of the decoder. Thus, we would have a reduced degree distribution resulting linear time encoding and decoding complexity. However, the decoder cannot decode all the input symbols with the lower degree distribution for the same overhead constraint. Therefore, utilizing an erasure correcting pre-code would then correct the erasures arising from the weakened decoder.

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4.1.2. The construction

LT codes are the first practical rateless codes for the binary erasure channel. The encoder can generate as many encoding symbols as required to decode k information symbols. The encoding and decoding algorithms of LT codes are simple; they are similar to parity-check processes. LT codes are efficient in the sense that the transmitter does not require an acknowledgement (ACK) from the receiver. This property is especially desired in multicast channels because it will significantly decrease the overhead incurred by processing the ACKs from multiple receivers.

LT codes are known to be efficient; k information symbols can be recovered from any k+ O ($\sqrt{k}ln^2$ (k/δ)) encoding symbols with probability1-δ using O (k.ln(k/δ)) operations. However, their bit error rates cannot be decreased below some lower bound, meaning they suffer an error floor.

In order to reduce the computational complexity, the number of edges at the encoder side should be reduced. LT codes can then be thought as sparse random linear Fountain Codes with simple encoding and decoding algorithms. Although, there are simple and fixed encoding and decoding schemes defined for LT codes the degree distributions of the edges play a crucial role in the design of *good* codes. Good codes are such codes, which have low encoding and decoding costs as well as a small overhead and a decoding failure. Let us start with the definitions of encoding and decoding schemes.

A. LT Coding

Any number of encoding symbols can be independently generated from k information symbols by the following encoding process:

1) Determine the degree d of an encoding symbol. The degree is chosen at random from a given node degree distribution P(x).

2) Choose d distinct information symbols uniformly at random. They will be neighbors of the encoding symbol.

3) Assign the XOR of the chosen d information symbols to the encoding symbol. This process is similar to generating parity bits except that only the parity bits are transmitted.

The degree distribution P(x) comes from the sense that we can draw a bipartite graph, suchAs in Figure(5), which consists of information symbols as variable nodes and encoding symbols as factor nodes. The degree distribution determines the performance of LT codes, such as the number of encoding symbols and probability of successful decoding. The degree distribution is analyzed.

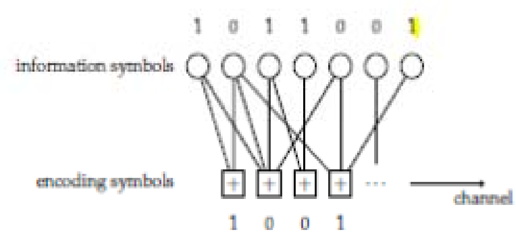

Figure (5): Generation of encoding symbols

The encoding symbols are transmitted through a BEC with the probability of erasure p. The special characteristic of a BEC is that receivers have correct data or no data. There is no confusion where the decoder needs to “guess” the original data; it recovers the true data or gives up.

B. LT Decoding

For decoding of LT codes, a decoder needs to know the neighbors of each encoding symbol. This information can be transferred in several ways. For example, a transmitter can send a packet, which consists of an encoding symbol and the list of its neighbors. An alternative method is that the encoder and the decoder share a random number generator seed, and the decoder finds out

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the neighbors of each encoding symbol by generating random linear combinations synchronized with the encoder.

4.1.3. Degree Distribution

LT codes do not have a fixed rate and hence the desired property is that the probability of success recovery is as high as possible while the number of encoding symbols required is kept small. Describing the property in terminology of the LT process,

- the release rate of encoding symbols is low in order to keep the size of the ripple small and prevent waste of encoding symbols;
- The release rate of encoding symbols is high enough to keep the ripple from dying out.

Therefore, the degree distribution of encoding symbols needs to be elaborately designed so as to balance between the trade-off. This is the reason that the degree distribution plays an important role in LT codes. We investigate several probability distributions as the degree distribution used in the Frame Fountain encoding process [10]. They are presented as follows:

1) Uniform distribution: $p_{i=1/n}\ \forall_i$ =1,2,3, ------------,n
2) Normal distribution: μ=[$n/2$], δ =k/2

$$p_i = \frac{1}{\sqrt{2\pi\delta^2}} e^{-\frac{(x_1-\mu)^2}{2\delta^2}} \forall_i = 1, \ldots\ldots, k;$$

Where
x_i= [randn*$\delta + \mu$]

3) sequential distribution:

$$p_i = \frac{1}{n-[n/k]} \forall_i = \left[\frac{n}{k}\right], \ldots., n$$

4) ideal solution distribution

$$p_1 = 1/n$$

$$p_i = 1/i(i-1) \text{ For } i = 2, 3, ----, n$$

5) Robust Soliton distribution first define R=c ln $\left(\frac{n}{\delta}\right)\sqrt{n}$where c and δ are extra parameters; c >0 is some suitable constant.

$$\tau_i = \begin{cases} \frac{R}{i_n}, & for\ i = 1,2, \ldots\ldots\ldots \left(\frac{n}{R}\right). \\ \frac{R}{n} ln\left(\frac{R}{\delta}\right). & .for\ i = \left(\frac{n}{R}\right). \quad o \\ 0, & otherwise. \end{cases}$$

enough frames can be encoded together as redundant frames to make sure there are enough diversity of encoded frames at the receiver.

4.2. Tornado code

4.2.1. Introduction

We introduce Tornado codes, a new class of erasure codes. Tornado codes first appeared in a technical report in 1997.These randomized codes have linear-time encoding and decoding algorithms. They can be used to transmit over lossy channels at rates extremely close to capacity. The encoding and decoding algorithms for Tornado codes are both simple and faster by orders of magnitude than the best software implementations of standard erasure codes. We expect Tornado codes will be extremely useful for applications such as reliable distribution of bulk data, including software distribution, video distribution, news and financials distribution, popular web site access, database replication, and military communications.

Despite the simplicity of Tornado codes, their design and analysis are mathematically

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interesting. The design requires the careful choice of a random irregular bipartite graph, where the structure of the irregular graph is extremely important. We model the progress of the decoding algorithm by a simple AND-OR tree analysis which immediately gives rise to a polynomial in one variable with coefficients determined by the graph structure. Based on these polynomials, we design a graph structure that guarantees successful decoding with high probability.

Tornado codes are erasure block codes based on irregular spare graph. Given an erasure channel with loss probability *p*, they can correct up to *p*. (1- ε) errors. They can be encoded and decoded in time proportional to *n*. log *(1/ ε)*. As shown in Figure (6), there are eight input symbols named *x*1, *x*2… *x*8. With tornado codes, four encoding symbols named *y*1, *y*2, *y*3 and *y*4 is produced by eight input symbols. Tornado codes can tolerate that any one of *y*1, *y*2, *y*3 and *y*4 can be recovered by three others. However, the complexity of encoding and decoding algorithms for tornado codes is proportional to block-length. This makes tornado codes not be adequate for large data transfer systems.

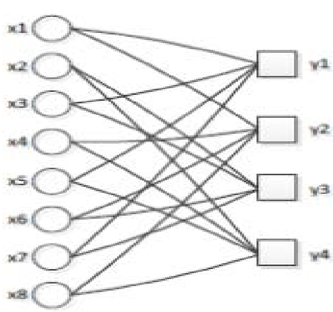

Figure (6): Tornado codes

Tornado codes belong to a new class of error-correcting codes for erasure channels, based on the construction of randomly connected irregular bipartite graphs. Using a carefully chosen graph structure, tornado codes can achieve nearly optimal efficiency, and with linear complexity for en- and decoding and rather simple and fast algorithms they are predestined for the encoding of large amounts of data, and as an alternative to the classical ARQ concept as used on the Internet.

Tornado codes are erasure block codes and hence not rateless based on irregular spare graphs [14]. Tornado codes are generated by cascading a sequence of irregular random bipartite graphs. These graphs are equivalent to generator matrices. The operation of one such graph is shown in Figure 7. The nodes on the left are known. The values of nodes on the right are computed by performing an XOR operation of the neighboring input nodes. Given an erasure channel with loss probability *p*, they can correct up to *p* (1- ε) errors. They can be encoded and decoded in time proportional to *n* log(1/ ε). Thus Tornado Codes has been primarily designed to speed up erasure codes over the internet.

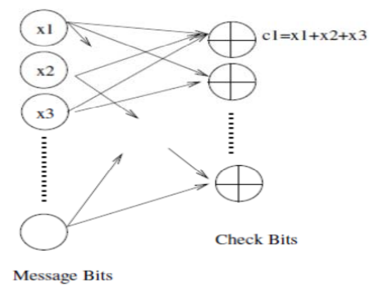

Figure (7): Irregular Bipartite Graph

4.2.2. Construction

We consider a system model in which a single transmitter performs bulk data transfer to a larger number of users on an erasure channel. Our objective is to achieve complete file transfer with the minimum number of encoding symbols and low decoding complexity. For k information symbols, RS codes can achieve this with k log k encoding and quadratic decoding times. The reason for the longer decoding time is that in RS codes, every redundant symbol depends on all information symbols. By contrast, every redundant symbol depends only on a small number of information symbols in Tornado codes. Thus they achieve linear encoding and decoding

complexity, with the cost that the user requires slightly more than k packets to successfully decode the transmitted symbols. The main contribution is the design and analysis of optimal degree distributions for the bipartite graph such that the receiver is able to recover all missing bits by a simple erasure decoding algorithm. The innovation of Tornado code has also inspired work on irregular LDPC codes.

4.3. Raptor code

4.3.1. Introduction

Raptor Codes are extension of LT codes combined with a pre-coding scheme,which can produce a potentially infinite stream of symbols such that any subset of symbols of size k (1+ε) is sufficient to recover the original *k* symbols, with high probability. Each output symbol is generated using *O* (log (1/ε)) operations, and the original symbols are recovered from the collected ones with *O* (k log (1/ε)) operations. The main idea of Raptor Codes is to relax the condition of recovering all input symbols and to require that only a constant fraction of input symbols be recoverable. Then the number of edges in the Tanner graph will exhibit only a constant degree, which will yield linear time encoding, and decoding costs. This is done by utilizing an erasure correcting pre-code working in linear time. The degree distribution, which is used for Raptor Codes, should be completely different from the one that of LT codes. Because, in the concept of Raptor Codes, we are forced to recover as many input symbols as possible for a given constant average degree rather than to recover all input symbols to be recovered and decoding to be successful. Raptor (rapid Tornado) codes were developed and patented in 2001 as a way to reduce decoding cost to *O* (1) by preprocessing the LT code with a standard erasure block code (such as a Tornado code). Degree distribution design and pre-coding is the heart of Raptor Codes. In order to understand Raptor Codes, one has to know the fountain approach to the coding theory

4.3.2. The construction

Digital Fountain, Inc. proposed Raptor codes in 2006. It is a concatenation of a systematic pre-code with LT codes. As shown in Figure (8), in the pre-code, *k* native symbols are first mapped to (1+ ε) *k* pre-coded symbols. Infinite coded symbols can be generated from pre-coded symbols by LT codes. In decoding process of Raptor codes, pre-coded symbols are recovered by LT codes firstly, and then input symbols are recovered by pre-coded symbols. Raptor code has been standardized in the 3GPP (Third Generation Partnership Project).

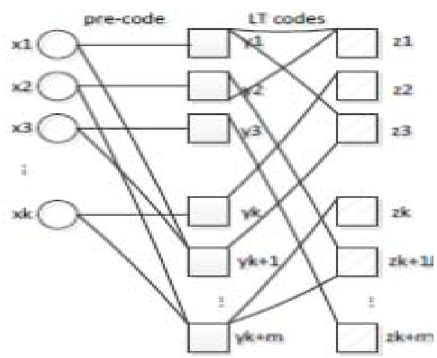

Fig (8): Raptor codes

A Raptor code can achieve constant per-symbol encoding and decoding cost with overhead close to zero and a space proportional to k. This has been shown to be the closest code to the ideal universal digital fountain. A similar vein of work was proposed in under the name online codes.

We have already seen two extreme cases of Raptor codes. When there is no pre-code, then we have the LT code. as an example of a pre-code only (PCO) Raptor code for the s are an extension of LT codes[11], which can produce a potentially infinite stream of symbols such that any subset of symbols of size k(1+ε) is sufficient to recover the original *k* symbols, with high probability. Each output symbol is generated using *O* (log (1/ε))

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operations, and the original symbols are recovered from the collected ones with *O* (k log (1/ε)) operations. The main idea of Raptor Codes is to relax the condition of recovering all input symbols and to require that only a constant fraction of input symbols be recoverable. Then the number of edges in the Tanner graph will exhibit only a constant degree, which will yield linear time encoding, and decoding costs. This is done by utilizing an erasure correcting pre-code working in linear time. The degree distribution, which is used for Raptor Codes, should be completely different from the one that of LT codes. Because, in the concept of Raptor Codes, we are forced to recover as many input symbols as possible for a given *constant* average degree rather than to recover all input symbols while maintaining the small overhead.

A. Raptor Coding

Raptor coding starts with a suitable design of the pre-code. Shokrollahi uses LDPC codes as a pre-code with a constant rate of (1+ε /2) (1+ε) and BP algorithm can work in linear time and decode (ε / 4) (1+ε) fraction of erasures where ε is a real positive number. Next, the intermediate symbols are encoded with LT coding using a suitable degree distribution.

In our design, we also considered LDPC codes as a pre-code of the Raptor Code. The average degree distributions used for LT codes are around $d_{av} = 3$. According to the ballsbins problem $e^{-3} \cong 5\%$of the input symbols are not recoverable on average. Therefore, the pre-code should have a capacity of correcting at least 5% of the erasures.

B. Raptor Decoding

Raptor decoding starts with the LT decoding process. In the example, LT decoding can recover all the intermediate symbols but the ones filled with black. Since the pre-code is systematic, the first three input symbols are immediately recovered. The fifth intermediate symbol is encoded by ex-oring the third and fourth input symbol. We can recover the fourth input symbol by adding the fifth intermediate symbol to the third input symbol. Hence, as it is seen that decoding process succeeds. Decoding is done the same way as described in this paper for LT decoding. LDPC decoding is performed using BP algorithm.

The table below summarizes the characteristics of various codes that are designed for the digital fountain ideal:

	Tornado	LT	Raptor
Rateless	No	Yes	Yes
Overhead	ϵ	$\epsilon \to 0$	$\epsilon \to 0$
Encoding complexity per symbol	$O(\epsilon \ln(1/\epsilon))$	$O(\ln(k))$	$O(1)$
Decoding complexity per symbol	$O(\epsilon \ln(1/\epsilon))$	$O(\ln(k))$	$O(1)$
Space per symbol	$O(1)$	$O(1)$	$O(1)$, with a larger constant.

Table 1: Summary of fountain codes

5. The Conclusion

This is clearly that the Fountain codes are flexibly applicable at a fixed code rate cannot be determined a priori, and where efficient encoding and decoding of large amounts of data is required.

1) Fountain codes are suitable for bulk data distribution over the internet.

2) The decoding time is acceptable when data rates are of the order of Mbps.

3) Possible when multiple clients over different quality of channels are being served simultaneously.

4)A more advanced Raptor code with greater flexibility and improved reception overhead, called Raptor Q, has been introduced into the IETF. This code can be used with up to 56,403 source symbols in a source block, and a total of up to 16,777,216 encoded symbols generated for a source block. This code is able to recover a source block from any set of encoded symbols equal to the number of source symbols in the source block with high probability and in rare cases from slightly

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ISSN 1947-5500

more than the number of source symbols in the source block.

References

[1] I. S. Reed and G. Solomon“Reed-Solomon code”. Polynomial codes over certain _nite _elds.Journal of the Society for Industrial and Applied Mathematics, 8:300{304, 1960.

[2] David Forney Jr. , .Unpublished Course notes., http://ssg.mit.edu/6.451 , 2003.

[3] S. Wicker and V. Bhargava, Eds., “Reed-Solomon Codes and Their Applications” IEEE Press,Piscataway, NJ, USA, 1994.

[4] J. van Lint,“ Introduction to Coding Theory” Springer-Verlag (2nd Ed.), 1992.

[5] G. Joshi, J .Bum Rhim, John Sun, Da Wang,“ Fountain codes”, December 7, 2010.

[6] Qingmei Yao, Chong Tang, Shaoen Wu Frame Fountain: Coding and Decoding MAC Frames.

[7]International Journal of Advances in Science and Technology, BER Performance of Reed-Solomon Code Using M-ary FSK Modulation in AWGN Channel Vol. 3, No.1, 2011.

[8]V. Korrapati, M V D Prasad*2, D. Venkatesh, G.Arun Tej “A Study on performance evaluation of Reed Solomon Codes through an AWGN Channel model for an efficient Communication System” International Journalof Engineering Trends and Technology (IJETT) - Volume4Issue4- April 2013.

[9] G. GÜL, S. Adhikari and E. Mustafin “Fountain Codes, LT Codes, and Raptor Codes”.

[10]Q.Yao, C.Tang, Sh. Wu School of Computing University of Southern Mississippi, USA “Frame Fountain: Coding and Decoding MAC Frames”.

[11]A. Shokrollahi and M. Luby Foundations and Trendsin Communications and Information Theory
“Raptor Codes” Vol. 6, Nos. 3–4 (2009) 213–322 _c 2011.

[12] J. Byers, M. Luby, M. Mitzenmacher, and A. Rege, “A Digital Fountain Approach to Reliable Distribution of Bulk Data,” In Proceeding of SIGCOMM, Vancouver, BC, CA, September 1998.

[13] J. Liao, L. Zhang, X. Zhu, J. Wang and M. Liao “ Loss Rate Based Fountain Codes for Data Transfer”

[14]A. Khisti “Tornado Codes and Luby Transform Codes” October 22, 2003.

[15] H. A. A. Elsaid, “Design and implementation of Reed-Solomon decoder using decomposed inversion less Berlekamp-Massey algorithm”, M. Sc. Thesis, Faculty of Engineering, Cairo University, 2010.

[16] A. Shokrollahi, \Raptor codes," IEEE Transactions on Information Theory, vol.52, no. 6, pp. 2551{2567, June 2006.

[17] J. D. Ellis, “Adaptive Transmission Protocols ForWirlessCommunication Systems WithFountain Coding” A Dissertation Presented to the raduate School ofClemson University, December 2013.

[18]M. Luby,M.Mitzenmacher, A. Shokrollahi, and D. Spielman, “Efficienterasure correcting codes,” *IEEE Trans. Inf. Theory*, vol. 47, no. 2, pp.569–584, Feb. 2001.

[19]R. G. Gallager,“Low Density Parity-Check Codes”. Cambridge, MA:MIT Press, 1963.

[20]D. J.C. MacKayCavendish Laboratory, University of Cambridge“ Fountain codes” 1998 IEE, Cagliari, ItalyProc. of the Fourth Workshop on Discrete Event Systems

An Optimal Energy-Efficient Clustering Protocol in Wireless Sensor Networks Using Genetic Algorithm

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Abstract—A sensor network has many sensor nodes with limited energy. One of the important issues in these networks is the increase of the life time of the network. This paper proposes a hybrid algorithm which, acts on the network and using genetic algorithm at first stage to choose the best sensors as a cluster head and using sleep/wake up mechanism for redundant sensors in the second stage. This algorithm will balance the energy consumption in the network and improve the network life time and coverage preservation.

Keywords-component, Wireless Sensor Network, Genetic Algorithm, Clustering, Sleep/Wakeup Mechanism, lifetime.

I. INTRODUCTION

All In recent years, the advancement of communication technology and electronic industry has lead to the production of relatively cheap and small sensors that establish communication through a wireless network [1]. These networks, which are known as wireless sensor networks, have become useful devices for getting data from the neighboring environment and monitoring environmental events. The application of these networks at home and in the army is increasing [2]. Works in the area of cluster-based wireless sensor networks is quite extensive, with energy efficiency and power consumption being the main focus of the clustering algorithm presented so far. Similar much research has been done on sensor activation algorithms, which focus on selecting some of the active sensor nodes that are enough to satisfy the network coverage requirements while allowing the remainder of the sensor to conserve their energy by entering the sleep state. In this section we discuss the related work that has been done in both these areas. In designing wireless sensor networks, the basic problem is the limitation of energy resource of the sensors and coverage preservation over long period of time. Moreover, because of the high number of the sensors in the network and lack of access to them, replacement or the charge of the sensor batteries is impossible. As a result, there is undoubtedly a need to introduce methods to optimize energy consumption and increase network life time [1].

Previous research shows that higher levels of energy efficiency can be achieved through organizing network nodes in clusters. Higher energy efficiency leads to increased network life time. In most studies network life is defined as the time period before the death of the first or the last node of the network [3].

Many clustering algorithm have been proposed [4,5]. A Typical clustering algorithm called low-energy adaptive clustering hierarchy (LEACH). LEACH algorithm is one of the most famous algorithms in wireless sensor networks. It has two phases: steady state phase and setup phase. At setup phase, transmission of data takes place one-hop. In each cluster, one node is chosen as the cluster head. The data collected from the member nodes are first processed locally in cluster heads. Then, they are sent in the form of a packet to the base station. As energy consumption in cluster heads is more than in normal nodes, their energy is used up after a while. For this reason, in LEACH, a rotation algorithm is employed for choosing cluster heads. All of this method can measure the life time of wireless sensor networks, but are not able to quantify the coverage of wireless sensor networks. The coverage metric in wireless sensor networks has been the subjective of increasing attention in recent years. The PEAS algorithm is a localize coverage algorithm, which supposes nodes have the same communication range and sensing range in the environment of asynchronous network [8]. This algorithm holds that close nodes have similar sense coverage range. In this algorithm, nodes which distances to the active node is too short can change their situation to sleep state. All nodes are in sleep state at the beginning, then node cycle awake and send detection message. All the active nodes within the communication range of this node receive this detection message and then judge whether the distance from this detection node is smaller than a fixed threshold. If it is so they send response message or they don't send any message. Detection nodes which receive response message will still be sleep, or they will be activated. Activated nodes will keep its activate state till the energy is finished. Though this algorithm has a good fault-tolerant ability, it cannot ensure fully covered area and easily causes coverage holes. In [9] authors propose a scheduling algorithm that enable each node to inter the active or sleeping state based on the coverage information obtained from its neighbors, without compromising full

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network coverage . In order to avoid blind pint problem that occurs when two neighbors nodes simultaneously decides to sleep and leaving the part of the area uncovered, the authors introduce a random back off time before the nodes make a decision about its state . In this research the blind problem is solved by introducing delays in node activation based on the current energy of the neighbored nodes. The problem of scheduling nodes to enter the sleep state in cluster-based sensor network was studied [10]. The authors proposed a linear distance based sleep scheduling algorithm, where the probability that a sensor enter the sleeping state is proportional to its distance from the cluster head. Whereas, this scheme causes to unequal power consumption of sensors' nodes.

II. LEACH PROTOCOL

First, LEACH is an algorithm for clustering for wireless sensor networks. The basic features of this protocol are as follows:

- ✓ The base station is away from the sensor nodes
- ✓ The base station is fixed
- ✓ All the sensor nodes have the same initial energy

In LEACH algorithm [1], each node produces a random number between [0, 1] and If the random number is below the threshold of T (n) (Equation (1)), the node is chosen as the cluster head. Where r, p and G are the number of current round, the desired percentage of cluster head and the set of sensor nodes which not selected as a cluster head in the last 1/p rounds, respectively.

The value of threshold for a sensor is formulated as Equation (1):

$$T(n)=\begin{cases}\dfrac{P}{1-P\times(r \bmod \frac{1}{p})} & n\in G \\ 0 & n\notin G\end{cases} \qquad (1)$$

When a node is selected as a cluster head, it broadcast a message for its neighbors. And the nodes receiving this message decide about joining one of the cluster heads based on the respective signal strength.

✓ *Problems of LEACH*

Depending on the thresholds, the number of cluster heads in some rounds is likely to be considered zero. In both of them, the position of nodes is disregarded when choosing cluster heads (distance between selected cluster head). This causes the density of cluster head nodes to be high in some points and low in other points. The nodes located in points that have low density use much energy to send the data to the related cluster heads (due to the great distance between nodes and cluster heads). These are the one of the main problem in Leach. As a result, a part of the network loses its connection with the rest of the network.

We will introduce a clustering algorithm that has two phases:

- ✓ Select cluster head with genetic algorithm
- ✓ Using Sleep/Wakeup mechanism for redundant nodes.

III. ROPOSED ALGORITHM

The purpose of this proposed algorithm is to solve the problems existing in leach algorithm. The proposed algorithm has the following capabilities.

- ✓ Applying the genetic algorithm to select cluster heads
- ✓ Applying Sleep/Wakeup mechanism to determine redundant nodes

➢ First phase

In the proposed algorithm, genetic algorithm is used for selecting the cluster heads. Several parameters in fitness function are used for selecting the cluster heads. The new method is based on the idea that instead of the primary clustering, the effective cluster heads are selected first, and then the nodes near these cluster heads are placed in the related cluster. After selecting the cluster heads, the command of membership is issued to each of the nodes. And based on its distance from the cluster heads, each node sends its request regarding its confirmation of membership to the nearest cluster head. The new method ensures that clusters have nodes with shorter distances in comparison with other clusters. Therefore, in contrast with other forms of clustering, we can save the energy required for sending the data to cluster heads.

The main criteria for fitness function that applied in this proposed method are as follows:

- ✓ Number of selected cluster heads

The main purpose of this proposed method is to obtain an optimal number of clusters. Since each cluster head is the representative of a cluster, the choice of cluster head K is in fact the same as the choice of cluster K. The purpose of defining this parameter is to study and organize the steps of sending data. With the increase of the number of cluster heads, the number of steps required for sending the data to the sink through cluster heads increases. As a result, this reduces the amount of the consumed energy.

- ✓ Distance between cluster heads

The distance of cluster heads from each other is another influential parameter in sending the data to the sink in sensor networks. In an operational environment covered by sensor networks, the distance of cluster heads from each other shows the degree of scattering of the nodes. The distance between cluster heads should be such that the cluster heads are neither close nor far from each other. If cluster heads are near each other, clusters are made in a compact form and with a high concentration. While in other points, clustering of nodes is formed with a weak concentration. On the other hand, the distance between cluster heads should not exceed the allowable threshold because sending data through cluster heads faces problems, and the consumed energy of the cluster heads.

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- ✓ Internal distance in clusters

Internal distance of clusters shows the degree of closeness of nodes to each other. If the internal distance of a cluster is a small number, it shows that the nodes are concentrated. And this concentration guarantees data gathering. On the contrary, if the internal distance of the cluster is a great number, it shows the great distance between the nodes. In a wireless sensor network if all the clusters are optimal (i.e., all the internal distance of the clusters are optima), the whole network is in an optimal status.

For getting a wireless sensor network in which the rate of consumed energy decreases, we can use another algorithm that selects clusters based on cluster heads. As it is clear from the title, we do clustering based on cluster heads rather than division of nodes. The proposed algorithm has two phases:

- ✓ First phase: select cluster head based on genetic algorithm
- ✓ Second phase: using sleep/wake up mechanism in each cluster for redundant nodes
- ➢ Second phase

This stage is design to solve the following problem: How can schedule nodes in the each cluster to sleep, so that the region can still have high coverage (coverage preservation) and maintain the longest possible life time.

To reach this purpose we do following steps:

- ✓ Each nodes send a message to its neighbor, that involve this information about sender node: id's node, position of node, remaining energy, angle of view
- ✓ Each node according to those parameter, calculate the amount of overlaps with its neighbors
- ✓ If the angle of view's node is covered with its neighbors, we can considered it as a redundant node
- ✓ After that redundant node was found we can turn it off.
- ✓ According to the remaining energy's neighbors (find lowest remaining energy), we assign a threshold for redundant nodes which shows the time that we should turn redundant nodes on.

Therefore, this algorithm can be summarized as follows:

- ✓ Random distribution of the sensors
- ✓ Cluster formation phase
- ➢ Select cluster heads using genetic algorithm
- ➢ Form the cluster
- ✓ Determine redundant nodes in each cluster
    - ➢ Turn redundant nodes off
    - ➢ Turn redundant nodes on according to its specified thresholds.

IV. SIMULATION AND RESULT

In this section, the efficiency of the proposed algorithm and Leach are estimated by Matlab. The primary model and presupposition of the wireless sensor network presented in this proposed algorithm is as follows:

- ✓ The network has N sensor nodes which are scattered randomly in a pre-determined environment.
- ✓ The sensors and the sink have a fixed position and are not moveable.
- ✓ All the sensors are identified based on the unique ID that they have.
- ✓ The nodes are informed of each other's positions through the strength of the signals that they receive.
- ✓ The presented algorithm runs in the sink and the result is announced to the nodes.
- ✓ The algorithm can be accomplished periodically or if the nodes are eliminated, it can be_accomplished again

In this simulation, the comparison criterion is the rate of consumed energy in sending two thousand random events in the sensor network. Due to the fact that the most waste of energy happens in sending messages, and the rate of energy consumption for receiving messages is equal in all sensors, in this paper we will focus on the rate of sending energy for a specified number of random events. The rate of consumed energy for sending K bits of data is obtained through Equation (3) as follows:

$$E_t = E_e + E_d * k \qquad (3)$$

K is the number of bits sent to the destination node. And E_e is the energy consumed by the electric and electronic equipment in the sensor itself. E_d Is the rate of energy changing based on the distance between source sensor and destination. E_d Is obtained through Equation (4) as follows:

$$E_d = \begin{cases} E_{AMP} * d^2 & d < d_{crossover} \\ E_{AMP} * d^4 & d \geq d_{crossover} \end{cases} \qquad (4)$$

In this equation, $d_{crossover}$ is considered as the threshold distance.

The parameters used in the algorithm are shown in Table.1

Table 1: Parameters of simulation

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Number of nodes	100
Area	100*100
Location of Base station	(100,100)
Initial Energy	1 J
e_{elec}	50nj/bit
ε_{fs}	10pj/bit/m2
ε_{mp}	0.0013pj/bit/m4
$d_{crossover}$	87

To study the performance of the new clustering algorithm, we also consider lifetime of the network as one of the main criteria for comparing methods. In the new proposed method, the lifetime of the method is studied as follows:

At first, the network randomly faces different events in different points. Each sensor located near the event senses it. Then the sensor sends the received data to the nearest cluster head. Now depending on the number of sent data and also the distance between the sensor node and the cluster head, the energy of the sensor decreases. Due to the abundance of events, with the passage of time the energy of some of the sensors finishes. And from then on, those sensors will not be able to send data. This is called sensor death. Now we can save the number of the alive nodes in each of the rounds. Based on this criterion, In Fig.1 the proposed algorithm and leach algorithm are compared. As it is observed, the proposed algorithm is more efficiency than leach algorithm.

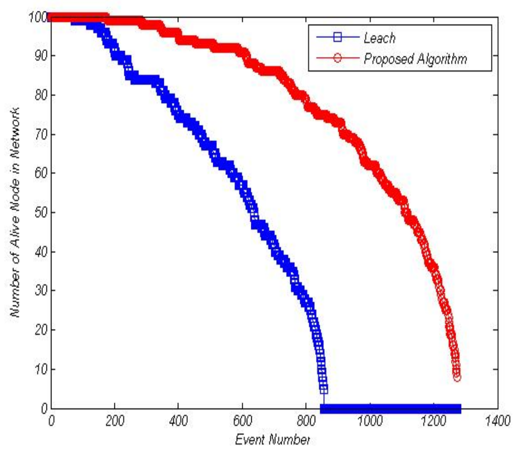

Fig. 1 comparison number of alive nodes between proposed algorithm and LEACH

In Fig.2, the energy consumption related to the proposed algorithm and Leach is demonstrated. Fig.2 shows the rate of energy consumption of the network until the first sensor is dead. The program's running will finish when the first sensor is out of energy. For example, As it can be seen, in Leach algorithm, while the energy of the whole network is 87J, in the 65^{th} round the first node gets out of energy and gets out of the network. However, in the proposed algorithm, the first node gets out of the network in the 180^{th} round with an existence of approximately 83J energy in the whole network. This matter shows that the proposed algorithm has a higher balance in the consumption of the energy of the sensors used in the network. And this is because of the balanced clustering in the proposed algorithm.

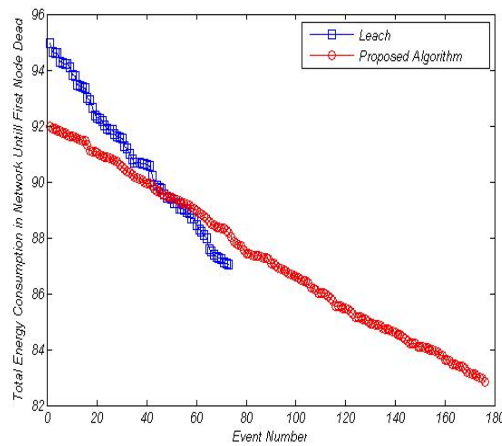

Fig. 2 comparison proposed algorithm and LEACH until the first node is dead.

In Fig.3, the proposed algorithm and leach algorithm is compared base on the parameter of the rate of energy existing in the network. As shown in the figures, the proposed algorithm has more efficiency than leach.

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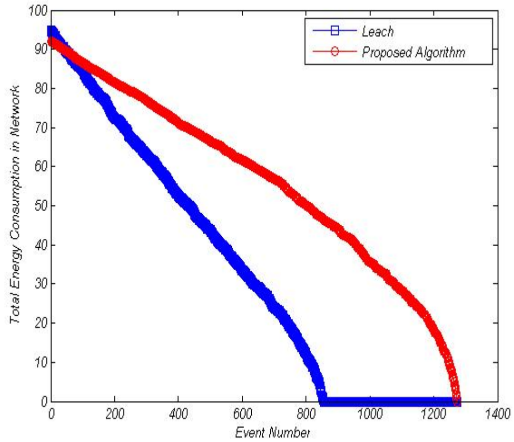

Fig. 3 comparison total energy consumption between proposed algorithm and LEACH

In the following tables, the proposed algorithm and Leach algorithm are compared regarding minim parameter of existing energy between the nodes of the network in subsequent rounds. For example, as it can be seen, for example, in Leach algorithm in the 20th round, the weakest sensor (i.e., the sensor with the least energy) has 0.39J of energy. However, in the proposed algorithm, the weakest sensor has more remaining energy.

Table 2. Comparison between proposed algorithm and LEACH in node with minimum energy in network

event / Weakest sensor	20^{th}	80^{th}	100^{th}
Proposed algorithm	0.76 J	0.55 J	0.41 J
Leach	0.39 J	0.01 J	0.0 J

V. CONCLUSIONS

The algorithm proposed in this paper is a smart and effective algorithm. The results obtained from simulation indicate that clusters have less internal distances. Therefore, our objective which was to gather data in the clusters was achieved. It needs to be mentioned that this algorithm is run in sink for the first time and then the output of the algorithm is announced to all the nodes. Configuration of the network is done in the BS for the first time. Then this algorithm can start reconfiguration of the network periodically or with the announcement of ending of energy by the cluster heads. Cluster heads have a balanced distance from all the internal nodes, and they also have more remaining energy than other nodes. Therefore, they are optimal and suitable representatives for the clusters. In this paper we focused on the issue of clustering by means of genetic algorithm. In this regard, we studied and focused on the kinds of clustering each of which affect the lifetime of the network in some way. Based on the algorithm presented in this paper, we obtained optimal clustering algorithm that increase network lifetime and improved coverage preservation.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and,

REFERENCES

[1] W.Heizelman, A.chandrakasan, H.balakrishnan. "An Application-specific protocol Architecture for wirelees Microsensor Networks". IEEE Transaction on wireless communication , vol1, no4, 2002, pp:660-670.

[2] I.Akyildiz, w.Su, Y.Sankarasurbra maniam. E.Cayirci. "A Survey on sensor networks". IEEE Communication Magazine,vol40, Issue8, 2002, pp:102-114.

[3] O.Younis, M.krunz, S.Ramasurbramanian. "Node Clustering in wireless sensor Network: recent developments and deployment challenges Network". IEEE ,VOL20 ,Issue 3, May-June, 2006, pp:20-25

[4] G.J.pottie, W.j.kaiser, " Wireless Integrated Network sensors. Communications" of the ACM, vol.43, ,2000 , pp:51-58.

[5] chuan –Ming liua, chan-Hsiu lee. Li –chanwang. "Distributed clustering algorithms for data gathering in wireless mobile sensor networks". J.Parallel Distrib.compute.67,2007, pp:1187-1200.

[6] S.Meguerdichian, F.koushanfar; G.Qu, M.Potkonjak. "Exposure in wireless Ad-Hoc Sensor Networks". Mobicom 2001

[7] X.wu; L.shu; M.meng; j.cho; S.lee. "Coverage-driven self –deployment for cluster based Mobile Sensor networks". proceeding of The sixth IEEE International conference on computer and information Technology (CIT'06)IEEE 2006.

[8] F.Ye; G.zhong, S.LU, L.zhang, PEAS. "A robust energy conserving protocol for long-lived sensor networks". proceedings of IEEE International conference on Distributed Computing systems, 2003.

[9] D.Tian, N.D.Georganas."A coverage-preserving node scheduling scheme for large wireless sensor networks". processing of ACM wireless sensor network and Application workshop, 2002

[10] J.Deng, Y.Han, W.Heizelman; p.varshney. "Scheduling sleeping nodes in high density cluster-base sensor networks". ACM/KLUWER MOWNET special Issue on energy constraints and lifetime performance in wireless sensor networks, VOL.10, NO.6, December 2005, pp:825-835.

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